No. 2645 VOLUME 76 FRIDAY 20 NOVEMBER 1959

FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

Official Organ of the Royal Aero Club First Aeronautical Weekly in the World Founded 1909

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IN THIS ISSUE

From All Quarters 566
Handling the DHC-4 Caribou 568
Missiles and Spaceflight 569
Service Aviation 571
Air Commerce 572
Flight Systems 575
Straight and Level 576
Commercial Aircraft of the World 577
Signals Command 622
Sport and Business 624
Correspondence 625
The Industry 626

Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1; telephone Waterloo 3333. Telegrams Flightpres Sedist London. Annual subscriptions: Home £4 15s, Overseas £5. Canada and U.S.A. $15.00. Second Class Mail privileges authorized at New York, N.Y.

Branch Offices Coventry: 8-10 Corporation Street; telephone Coventry 25210. Birmingham: King Edward House, New Street, 2; telephone Midland 7191. Manchester: 260 Deansgate, 3; telephone Blackfriars 4412 or Deansgate 3595. Glasgow: 26B Renfield Street, C.2; telephone Central 1265. New York, N.Y.: Thomas Skinner & Co. (Publishers) Ltd., 111 Broadway, 6; telephone Digby 9-1197.

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Facts and Figures Wanted

THERE is now little doubt that this country's air transport industry is to be regulated, and we hope fostered, by the sort of executive authority frequently proposed over the past two years in these pages. Titles can be quite important, and we are glad to hear that the new executive may be given the name of our own choice—Air Transport Board.

One section of British air transport that will probably be affected more than any other by the new Board will be the independent airlines. Their club, the British Independent Air Transport Association (which accounts for perhaps 90 per cent of the British independents' traffic), has recently issued its 1958-59 annual report. If the Board were in existence now it might well be curiously analysing this report, as we have been. Its content, not for the first time, is largely malcontent.

Yet, in the year under review, B.I.A.T.A.'s traffic went up ten per cent, an increase bigger than was achieved by either Corporation in 1958-59. And though the report says that "the demand for scheduled [services] has fallen" in fact demand went up overall by 20 per cent. We do not think that the report is being insincere; but this apparent contradiction does call for two important qualifying comments. First, collective reporting can distort the true picture. A big increase by a big operator like Silver City can easily make everything in the overall garden look lovely, or vice versa. Second, like-with-like comparisons are made difficult because B.I.A.T.A.'s year, which ends on June 30, includes part of two different peak summer seasons.

The first job for the new Air Transport Board will be to call for *individual* independent traffic—and cost-revenue—statistics, for charter as well as for scheduled operations, and for the March 31 year. Only then will we know what is really happening in our air transport industry.

Sharing Operational Control

CONFIRMED in possession of Coastal Command, and with a new tactical group added to Transport Command, the R.A.F. may well be patting itself on the back. With Services on either side eager for a little more control over air power in their own spheres, the main practitioner has nevertheless managed to keep hold of the transport support and land-based maritime air forces. Whatever inter-Service arguments there may have been behind the scenes, the solution exemplified in these recent announcements is surely a quite logical one. The aircraft concerned are all big: Shackletons, Beverleys, Hastings, the forthcoming AW.660s; and the R.A.F. has been handling big aircraft with pronounced success since the days of the Handley Page 0/400 and Vickers Vimy. Its technical control is not disputed; and the new arrangements show that operational control is to be shared on a sensible inter-Service basis. As to Coastal Command, the Minister of Defence has made it clear that the senior Naval commander in a particular area will decide the tasks of shore-based maritime aircraft in operations or exercises; and the new set-up of No. 38 Group is to include staff posts specifically allotted to Army officers, and a specialist commander with whom Army formations can deal directly. Joint planning is universally accepted nowadays, and as exemplified in these new decisions shows a traditionally British spirit of compromise.

FROM ALL QUARTERS

Hawker Siddeley CT-41

ON November 16 an agreement was signed in Paris between the Hawker Siddeley Group and Nord-Aviation under the terms of which the British firm can manufacture, maintain and service the CT-41 target. The CT-41, first illustrated in our April 17 issue (p. 513), is a supersonic drone which combines outstanding performance with simplicity of design.

Powered by twin fixed-geometry ramjets mounted on the tips of its stubby, rear-mounted wing, it is a canard with the following basic particulars: span, 12ft 3in; length, 32ft 2in; maximum body diameter, 20in; wing area, 33.3 sq ft; empty weight, 1,764 lb; gross weight, 2,866 lb; launch weight, with twin boost motors, 5,622 lb. The CT-41 is radio-controlled and the whole vehicle system leans upon Nord's great experience acquired with the earlier CT-10 and -20.

Manpowered Flight Incentive

A PRIZE of £5,000 for the first successful flight of a man-powered aircraft designed, built and flown within the British Commonwealth has been offered by Mr. Henry Kremer, chairman and managing director of Microcell Ltd. Conditions for the flight are to be specified by the Royal Aeronautical Society, and the Royal Aero Club is being invited by the Society to provide official observers.

The offer of the award was conveyed to the R.Ae.S. President in a letter from Mr. R. Graham, executive director of Microcell and a member of the committee of the R.Ae.S. Manpowered Aircraft Group. In announcing the award the Society state that the prize is being offered personally by Mr. Kremer and not by any of his companies.

Hovercraft—the Next Stage

SINCE the SR-N1 was shown at Farnborough in September more than 150 enquiries for Hovercraft have reached Hovercraft Development Ltd. These have been analysed, and now a stage has been reached where specifications for new vehicles have been drawn up and are ready to go out to tender. H.D.L. say they have learned a great deal from these enquiries and envisage that in the next two to five years four or five different types of ground-effect vehicles will be built—for land, amphibious, rivercraft and ferry applications.

The rôles that these new Hovercraft will fill may be (a) as replacements for four-wheel-drive trucks over country where roads are non-existent, (b) as snow tractors (possibly with living accommodation), (c) for building early-warning radar lines, (d) for oil and mineral work in desert areas, (e) for service in remote coastal waters (interest has been expressed in Chile), and (f) eventually as ferries for passenger carrying. They will cruise at speeds of between 40 and 60 kt, hover at heights of around 2ft (less over land, perhaps more over water) and weigh in the region of 40 tons. And they will provide experience on a broad front before the ultimate 400-ton or larger craft are seriously considered.

Contracts for construction of these vehicles are shortly to be put out to industry. In the first place this assumes the aircraft industry, because a knowledge of light structures and airflow is a pre-requisite to Hovercraft design. Hovercraft knowledge is still mainly centralized with H.D.L., and they will make available their research and development knowledge to firms "of some substance with a decent technical organization."

In London last week Mr. Dennis Hennessey, chairman of Hovercraft Development, was able to say that the money—amounting to millions—would be forthcoming. It would come in the normal way through the National Research and Development Corporation, some possibly from "the private sector" and certainly some from the first customers for commercial Hovercraft. Considerable interest in these ground-effect vehicles had been expressed by governments and private concerns in Commonwealth territories.

"Flight" photograph

FAMILY SEND-OFF: In the foreground are the two Comet 4Bs delivered last Monday by Sir Aubrey Burke of D.H. to Lord Douglas of B.E.A. (see page 572). In the picture, taken at Hatfield just before the ceremony, are representatives of all the current-production D.H. transport family except the Caribou—Dove, Beaver, Heron, Otter, Comet 4

Discussing Hovercraft development in the United States, Mr. Hennessey and Mr. C. S. Cockerell (the inventor) said that there was no doubt that ground-cushion vehicles were not accepted in the same way as they are in the United Kingdom: "There are a lot of people engaged, but the effort is spread rather thinly." Plenum-chamber vehicles (for example, the Curtiss Wright Air-Car) had only a limited development potential and the U.S. recognized this fact. In general the American ground-effect machines that had been built carried only one man and "were not capable of going from A to B." Discussing the important matter of British Hovercraft patents in the U.S.A., Mr. Hennessey said that his company's attitude was "relaxed."

Hamble Changes

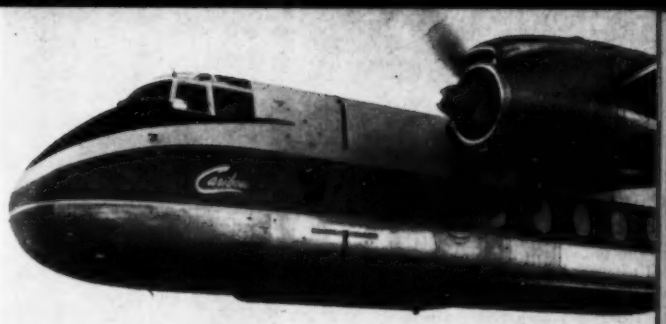
NEW directors of Folland Aircraft Ltd. have been appointed since the company's acquisition by the Hawker Siddeley Group. The reconstituted Board is as follows: Sir Roy Dobson, chairman; Mr. J. T. Lidbury, managing director; Mr. J. A. R. Kay,

ON FOLLAND BOARD: Messrs. Lidbury, Kay, Brade and Colley

director; Mr. S. D. Davies, technical director; Mr. D. G. Brade (formerly chief development engineer), general manager; Air Marshal Sir Richard Atcherley, sales director; and Mr. J. K. Colley, director.

Messrs. C. L. Hill, W. E. W. Petter, E. C. Lysaght and C. E. Blunt have resigned from the Board and Mr. Petter has relinquished his appointment as managing director and chief engineer. He will, however, be associated with Hawker Siddeley Aviation Ltd. as a consultant. Mr. J. A. Boulger, who was formerly deputy chief designer, now becomes chief designer.

WARTIME ASSOCIATION between Regent Motors (Cheltenham) Ltd. and the Gloster Aircraft Co. was recently marked by the unveiling in the former company's Cheltenham showrooms of a picture of the Gloster E.28/39. On the site of the showrooms this historic aircraft was built. Here, with the picture, are (l. to r.) Cllr. A. G. Dye, Mayor of Cheltenham; Mr. G. Readings, Regent Motors chairman; Mr. George Carter, E.28/39 designer; Mr. Hugh Burroughes, Gloster Aircraft chairman; and Mr. James Martin, the artist



***FORE AND AFT:** In the "Flight" close-up (right), the DHC-4 Caribou shows its characteristic bluff nose and P. and W. R-2000 engines slung low on the inverted gull-wing. Below, airborne troops are going aboard through the rear doors. An air-test report appears on page 568, and cockpit pictures on page 575*

Farnborough in Perspective

WORDS of wisdom from on high are not always acceptable to those down below, but when offered by so genial a Moses-figure as Sir George Gardner blend charm with authority. Such was the case when he delivered the sixth Sir George Cayley Memorial Lecture to the Brough branch of the Royal Aeronautical Society on Wednesday last week; and his subject, *The Royal Aircraft Factory, Farnborough, and the Early History of the Aeroplane*, was one eminently suited to the present Controller of Aircraft at the Ministry of Aviation and former Director of the R.A.E. Farnborough.

Sir George's lecture, covering aeronautical developments from 1878 and the history of the Royal Aircraft Factory from its origin as the Balloon Factory to the end of the First World War, had one main theme underlying its historical counterpoint: that the Factory and its successor the R.A.E. were not competing with industry but collaborating with it—a collaboration which, he said, he hoped would continue indefinitely. This state of affairs, however, had not been reached without considerable vicissitudes. Rumblings of criticism started as early as 1912; it was alleged that the Factory's policy was to undermine private industry. There was a full-scale Parliamentary attack in 1916, which led to changes at Farnborough, Col. Mervyn O'Gorman being replaced as superintendent by Mr. Henry Fowler of the Midland Railway. But Fowler's careful investigation exonerated the Factory, and he said later that the influence of its great work on "the ultimate supremacy of the British Air Force" had never been properly recognized. Sir George paid a warm tribute to O'Gorman, who gathered together such a brilliant team at the R.A.F. (including Lindemann, Green, Farren and Keith-Lucas) and who "did so much to establish the science of aeronautics."

It was hardly to be expected that so alert a membership as that at Brough would let such a distinguished visitor get away without some searching questions to answer, and these ranged from the correct designations of First World War aircraft produced by the R.A.F. to the "ten-year cycle" of production nowadays and a comparison with the time taken by the Russians. The questions were a tribute to Sir George's authority as an answerer; and as a tribute to his visit as a lecturer the branch presented him with a handsome inscribed silver dish, an acceptably tangible memento of the sixth Sir George Cayley Lecture.

Farnborough in Colour

FOR the first time, the Central Office of Information film of the S.B.A.C. Display at Farnborough has been made in colour (Eastmancolor) thus doing full justice to the brilliant weather conditions which this year marked the occasion. Made by British Movietonews on behalf of the C.O.I., the 15-minute film—*This is Farnborough*—contains some admirable camera work, edited to give a nice balance between ground and air-to-air shots. Produced by J. L. Ramsden and photographed by Norman Fisher and David Samuelson, it is being distributed throughout the U.K. by 20th-Century Fox and (with a commentary recorded in English and 16 foreign languages) will be shown overseas in 83 different countries.

IN BRIEF

The Bristol Siddeley Orpheus 12 flew for the first time on November 10, when Tom Frost, the company's chief test pilot, was airborne for 25 min with a Sabre test-bed operated from Filton. He afterwards expressed complete satisfaction.

Lt-Gen. Donald L. Putt, U.S.A.F. (retd.), has been elected president of the Institute of the Aeronautical Sciences for 1960.

Mr. E. R. Lewis, chairman of the Decca group, and G/C. E. Fennessy, managing director of Decca Radar Ltd., have joined the Board of General Precision Systems Ltd. following Decca Radar's acquisition of a 25 per cent interest in that company. Co-operation in the development of air traffic control systems was recently announced (*Flight*, October 30).

A technical sales team from Westland Aircraft Ltd. and Saunders-Roe Ltd. is leaving shortly for India to discuss helicopter requirements there. Headed by Mr. Leonard Thornhill, Westland sales representative, who is also a helicopter pilot, it includes the company's chief designer, Mr. P. E. Q. Shunker, and the Saunders-Roe assistant chief designer, Mr. C. Faulkener.

Completing its 1959 development lifting-programme, the Westland Westminster has now lifted the 103ft MEXE bridge span complete with decking. Westland state that the decking, with an unbroken area of 1,350 sq ft, imposes aerodynamic loads which more than double the effective weight of the bridge. Flown by "Slim" Sear, the Westminster carried this formidable load at nearly 70 kt and made turns involving 30 deg of bank.

The three Whirlwinds flown to the Persian Gulf by Bristow Helicopters Ltd. (page 485, *Flight*, November 6) arrived on November 7, covering the final Beirut - Kuwait sector in one day.

Last week the U.S. Navy placed a £21m repeat order for A4D-2N Skyhawks with the El Segundo plant of Douglas Aircraft. A number of these J65-powered (Sapphire licence) strike aircraft are on test from Edwards and first deliveries are imminent.

Bell Helicopters are now taking orders for the 47G-3, powered by the turbosupercharged Franklin 6VS-335. Incorporating many other improvements, the G-3 has already performed some remarkable feats. At Pikes Peak, Colorado, a prototype lifted its own weight (1,539 lb) and also made an autorotative landing at density altitudes between 15,400 and 17,500ft.

***NEW AVRO TEST PILOT** is Mr. Colin Allen, who at 35 years of age has wide flying experience, gained in the Royal Air Force (1943-47), Central African Airways, British European Airways and the Royal Auxiliary Air Force. His last appointment (1952-59) was with Vickers-Armstrongs (Aircraft) Ltd. at Weybridge, where he was a production and experimental test pilot on Valiants and Viscounts*

Mr. Harold H. ("Tim") Wood, chief test pilot of Blackburn and General Aircraft Ltd. until his retirement earlier this year, has joined the Microcell Group where he will be concerned with special sales liaison duties.

"Little Joe," the Convair B-58 Hustler which flew from Fort Worth, Texas, to Edwards A.F.B. at M 1 below 500ft (*Flight*, October 16), recently flew from Seattle to Fort Worth in 80 min; the air distance was 1,680 miles, and the mean speed 1,260 m.p.h. The pilot was Raymond Fitzgerald, who, with his observer, was killed on November 7 when another B-58 exploded over Lawton, Oklahoma.

An eight-man Scottish delegation which included the M.P.s for Ayr and Kilmarnock (Sir Thomas Moore and Mr. William Ross respectively) and the managing director of Scottish Aviation Ltd., Mr. T. D. M. Robertson, discussed with the Prime Minister and Minister of Aviation on November 11 the possibility of putting the Pegasus into service with the Army Air Corps. The ministers were non-committal.

A readiness exercise involving the movement of a hundred-odd F-100s, with supporting transports, from California to France was conducted by the U.S.A.F. last week. Known as the Tactical Air Command Composite Strike Force, the aircraft put down at Chaumont and Laon, whence they were to conduct "realistic exercises" for about a week before returning to their U.S. bases.

Handling the DHC-4 Caribou

THE ninth DHC-4 Caribou, registered CF-LVA, was in England last week for a series of demonstrations to civil operators and the Services, both British and NATO. Five Caribous have been accepted by the U.S. Army, who wrote a specification round the original design, and CF-LVA is now on an extensive tour of Europe and the Middle and Far East.

Although the very specialized performance of the Caribou suggests a mainly military aircraft, it is also aimed at civil sales. Philippine Airlines have indeed stated an interest in a transport to carry 30 people out of Otter-size strips—which is what the Caribou will do. Present gross weight is 26,000 lb and cruising speed 182 m.p.h. at 50 per cent power. The P. & W. R-2000 was chosen because it was the only powerplant with the gear ratio of 0.5 : 1 needed to meet the take-off r.p.m. case and has some fifty million operating hours behind it. Incidentally, pitot heads on each engine nacelle measure thrust, which is indicated in the cockpit. If thrust becomes asymmetric beyond a given point, the deficient engine is automatically feathered.

The company proposes the Caribou in competition with the freight helicopter which, at present, shows about the same field performance when fully loaded. The Caribou can variously carry 30 equipped troops; an airline seating layout with galley, toilet and baggage space; 24 stretchers; or "hard" loads such as two jeeps. Doors each side admit passengers, while a trapdoor under the very high tail allows rapid loading of freight or vehicles. This door can be opened electrically in flight or jettisoned in emergency, and the short ramp panel may be electrically adjusted to maintain truck-bed level. Roller conveyors stowed in the aircraft can be used for freight and small ramps can be carried to facilitate rapid troop boarding or vehicle loading.

The control aerodynamics are worth studying, for few of them are readily apparent. Double-slotted, high-lift flaps are lowered to a maximum of 50 deg. They extend out to the wing fences, outboard of which is a fixed leading-edge camber. Double-slotted ailerons are also fitted in two sections each side. The forward section forming the double slot, in conjunction with the inboard flaps, moves purely as a flap. The rear sections form the ailerons, but the inner panels move only slightly when the flaps are in. When these are lowered all aileron panels move fully to give good lateral control. Servo assistance is provided by geared tabs on the outer panels, a trim-tab being attached to starboard. A further tab on the inner starboard section is directly connected to the rudder to give a righting effect during sustained side-slipping—or, conversely, to produce a co-ordinated turn from rudder alone.

The elevator is spring-tab-operated, with a further tab for trimming-out loads from speed and power changes. Trim-changes from flap movement are largely taken out by automatic movement of the tailplane. The very large rudder has a spring tab and a combined geared tab and trimming surface. None of this, as I have suggested, is readily apparent; but it adds up to smooth and effective control on all axes right down into the stall, which is what C.A.R.4b requires. In addition, to meet the stall-warning requirements—which are of dubious value for STOL operations—leading-edge beaks are fitted just outboard of the engine nacelles and each control wheel has a stick-shaker, which most operators will probably disconnect.

The two-pilot crew sits on a high shelf under 32 sq ft of transparency giving excellent visibility, including both wing-tips and the mainwheels—this is good for small fields and soft ground. The nosewheel is steered hydraulically from a tiller wheel and powered disc-brakes are operated from toe-pedals. Turning radius with steering alone is 30ft 6in. Standard instruments are on the main panels, with a centralized emergency panel high in the centre. Seats and rudder pedals are adjustable and all radio controls, for full airline equipment and more, are set in a drawer-type console which can be shoved out of the way beneath the instrument panel. Throttle, pitch, mixture, ignition switches, rudder trim, undercarriage and flap controls are set in the roof, very comfortably for the first pilot to reach, leaving the elevator trim wheel beside the captain's seat and the aileron trim as a rocking button on the outboard horn of each control wheel. Controls are locked by a heavily-sprung lever which positively blocks the throttles when engaged. All fuel controls are on a single, small, diagrammatic panel beside the captain's instruments and electric generating controls are in an equivalent position beside the co-pilot's panel. Cabin and cockpit heaters are provided.

I spent some time "jerking gear" for D.H.C. test pilot Dave Fairbanks before we went up on our own and I took over to get the feel of things. The Caribou behaved much better than I expected; and it can be flown solo if necessary. I liked the roof-mounted controls.

Straight and level at about 160 m.p.h. at 5,000ft, it flew naturally and steadily, with good, positive longitudinal stability and light, responsive ailerons. Steep turns were easy with a good tug back on the wheel and the aircraft entered turns well with either rudder or aileron alone. The rudder, being spring-tab-operated, was a little spongy, but the elevators, operated in the same way, had a pleasant springiness which did not detract from their response. Dave then reduced the starboard engine to zero thrust and the speed stabilized at 130 m.p.h. with 31in and 2,050 r.p.m. A quick tweak at the powerful rudder trimmer allowed hands-off flight and rapid turns could be made with and against the thrustless engine. With climb power on the port engine at 108 m.p.h. I was again able to trim hands-off and we made no less than 1,000ft/min climb at 5,000ft, though we were lightly loaded. Down at 90 m.p.h. I still had control and trim to spare.

DE HAVILLAND CANADA DHC-4 CARIBOU
(Two P. & W. R-2000 giving 1,450 h.p. each)

Span, 96ft; length, 72ft 7in; height, 31ft 10in; wing loading, 28.5 lb/sq ft; power loading, 8.97 lb/h.p.; empty weight, 16,850 lb; gross weight, take-off and landing, 26,000 lb; cruising speed at 7,500ft with 50 per cent power, 182 m.p.h.; stalling speed, full flap, 62 m.p.h.; sea-level climb, 1,575ft/min; single-engined climb, 345ft/min; single-engined service ceiling, 11,900ft; take-off run with 30 deg flap, 540ft; distance to 50ft, 1,020ft; CAR-4b take-off field length, 2,560ft; landing run, 525ft; landing over 50ft, 1,020ft; extreme range, 1,400 st ml.

Low-speed flying was entertaining. The flaps moved very slowly so that there was plenty of time to trim out the considerable forces remaining after the tailplane had followed up. Attitude changes were pronounced (as they are in the Otter) and took a little getting used to, but stick forces remained almost continually in the one-handed region. Lateral control at low speeds was effective so long as full travel was used and in bumpy air I had to work quite hard. Once accustomed to being apparently brutal with the ailerons, I got everything I needed despite severe gusts. The rudder is big: it felt huge, yet light. Yaw inertia seemed to be high and rudder had to be used sparingly to avoid over-controlling, but the right habit was easy to acquire. At 80 m.p.h. and less the elevators were outstanding, remaining precise and light.

I stalled the Caribou clean with power off, finding full control right down to the break-away point at around 80 m.p.h. The nose came well up and speed dropped off slowly. Minimum recovery action was needed. More interesting was the stall with everything down. Gear extended with a hydraulic screeching, causing a slight nose-down trim-change. Progressive flap made one reach for the trim-wheel fairly soon and I had to get the nose right down to hold speed. When the A.S.I. passed 70 m.p.h. the nose began to come up again as I held a steady reduction in speed, until very slight warning announced the incipient stall and the right wing began to fall away. Recovery was again straightforward. With gear up, full flap down and no power the Caribou went down at over 2,000ft/min, seemingly pointing straight down. In this configuration it can be landed at gross weight without power, Dave said, there being ample elevator for round-out.

Take-off was excellent. Opening up, and letting go the brakes as the boost passed 30in, Dave steered the nosewheel for about 5 sec, I pulled hard back on the wheel at 50 m.p.h. and the Caribou rotated straight into a climb without leaping or lurching. Undercarriage retraction was very rapid and flap could be selected up straight away. It came in very slowly with no apparent sink and slow trim-changes. Similarly, landing was straightforward, even when fighting a really rough 20 kt wind. Visibility at all times was exceptionally good and the aircraft was easy to keep straight during landing. The round-out was considerable, touch-down being made with the tail well down. The two-stage oleos can take 840ft/min impacts and the twin tyres are inflated at 32 lb/sq in.

To sum up, I found the Caribou tractable, good on one engine and apparently viceless. Field performance, both in terms of length of run and ease of control, was truly remarkable. This aircraft sets new standards in big, conventional STOL types.

MARK LAMBERT

The Caribou taking off from Hatfield. Cockpit picture: page 575
"Flight" photograph

Missiles and Spaceflight

On November 7 two Nike Hercules of the U.S. Army were fired from Bolo Point, Okinawa, before 300 newsmen. Both were launched against 300 m.p.h. targets and achieved "successful" missions. Hercules have not been fired elsewhere outside the United States

DELTA TIMETABLE

The provisional launch programme for the Thor-Delta interim space vehicle includes four satellites and one space probe during next year. These comprise a 100ft inflatable passive communications reflector intended for a 1,000-mile circular orbit, scheduled for March; a 65 lb-payload lunar probe in June; a 270 lb meteorological satellite designated Tiros 2 and intended for a 460-mile orbit, in August; an 82 lb radiation satellite, elliptical orbit (170-46,000 miles), in October; and a 300 lb solar-spectroscopy satellite, circular orbit at 460 miles, in December. A total of 12 shots are planned up to March 1962.

Basically a three-stage development of the two-stage Thor-Able vehicle, Thor-Delta consists of a first-stage Thor (weight 106,763 lb, thrust 150,000 lb), a second-stage Aerojet LR118-AJ-10 (weight 4,686 lb, thrust 7,800 lb), and a third-stage solid-propellant Allegany Ballistics Laboratory X-248-A5 Delta (weight 522 lb, thrust 3,100 lb). The complete vehicle is 91ft long. The complete third stage was recently flight-tested in the Wallops Island launching of the 100ft inflatable sphere on October 28 (*Flight*, November 6).

LITTLE JOE II

The Project Mercury pilot-escape system was successfully tested on November 4, when a 2,000 lb boilerplate model of the capsule was fired to 33,000ft from Wallops Island by a Little Joe booster. The escape rockets, mounted on the 16ft pylon attached to the capsule, were then fired (for a duration of 1 sec), separating the capsule from its booster and carrying it in a wide arc to 35,000ft.

After a 20-sec coasting period the escape pylon was jettisoned, and a drogue parachute was deployed 30 sec later. Three minutes after separation, at about 10,000ft, the main parachute was opened to reduce the rate of descent to 30ft/sec. Recovery of the capsule was effected 45 min after launch (see photographs overleaf).

In the first Little Joe launch of a Mercury capsule on October 3 the normal complement of four Pollux and four Recruit boosters were successfully tested. The combination used to obtain the planned trajectory on November 4 comprised two Pollux and four Recruits.

The Little Joe shots were preceded by the highly successful Big Joe firing on September 9, in which a full-size capsule was launched by means of an Atlas in what NASA describe as "a severe test of the ablation heat shield similar to the one which will be used on the Project Mercury manned capsule." On this occasion the capsule, which contained over 150 separate measuring devices to provide information on temperatures, pressures and accelerations, successfully withstood 3,000 deg F and 14,000 m.p.h., and was recovered. The Big Joe experiment also provided favourable data on aerodynamic stability and operation of the parachute landing system, and was deemed so effective in proving theoretical and laboratory design concepts of the manned capsule that a second Big Joe shot planned as a back-up was not required. The ablative heat shield was developed by the B. F. Goodrich Co.

TURKISH JUPITERS

It was announced in Washington earlier this month that a bilateral agreement has been reached between the U.S.A. and Turkey for the establishment of a squadron of Jupiter IRBMs in the latter country. Like the two similar squadrons—presumably operated by U.S.A.F. Strategic Air Command—which are scheduled to be deployed in Northern Italy, the Turkish squadron will be assigned to international control as a NATO force; the warheads will, however, remain in American custody. Initially the squadron will be operated by Strategic Air Command crews, but it is intended to replace these eventually with Turkish personnel.

The eighth firing of a Thor IRBM by an R.A.F. crew was successfully made from Vandenberg A.F.B. on November 12.

The news that the Soviet space probe Lunik 3 had ceased radio transmission was given in an article in *Pravda* on November 14 by Academician Leonid Sedov. The probable reason quoted was collision with a meteorite and consequent puncture of the probe's pressure shell.

The November 11 copy of *Rolls-Royce News* states: "The first firing test of a Rolls-Royce rocket engine at Spadeadam rocket engine test site in Cumberland was made recently. The test was successful. Previous R-R rocket engine firings have been made at the Ministry of Supply testing site at Westcott. . . ."

On November 10 the U.S. Army launched a five-stage Strong-Arm rocket from the NASA station at Wallops Island, Virginia. The Army are interested in measuring environmental conditions in the high atmosphere, and the firing was intended to record electron densities at altitudes between 500 and 875 miles. Apogee reached was 1,050 miles.

Three years ago a Martin B-57B was fitted with the front end of a Boeing IM-99A Bomarc to assist in flight-testing the missile's guidance system. This second B-57B is likewise Bomarc-nosed, but in this case the missile is the high-performance IM-99B. The B-57 (Canberra derivative) will prove the ability of Eglin Gulf Test Range to handle the longer - ranged Bomarc

Missiles and Spaceflight . . .

Meteorological applications of artificial Earth satellites were discussed last week by a panel of experts convened at Geneva by the World Meteorological Organization. Dr. G. D. Robinson of the United Kingdom was panel chairman.

Dr. Keith Glennan, NASA administrator, said earlier this month that the Project Mercury programme was exactly on schedule. He estimated that there would be 20 experimental shots in the next 14 months prior to putting a man into orbit.

Radar echoes from the planet Venus have been obtained by scientists at Manchester University's Jodrell Bank Experimental Station, using the 250ft steerable radio telescope. This experiment, forecast in *Flight* of August 28 last, was carried out during September and was described to the Duke of Edinburgh during his visit to Jodrell Bank on November 11.

A $14 million research and development centre devoted to space technology is to be built by the General Electric Company. This will form part of the company's missile and space vehicle department and will be located on a 130-acre site near Philadelphia. The department employs some 3,500 people in the Philadelphia area at present.

Mr. Charles Louis Critchfield, director of scientific research for the Convair division of General Dynamics, has been appointed director of the Advanced Research Projects Agency of the U.S. Department of Defense. He succeeds Mr. Roy Johnson, who has retired to become a professional artist. Mr. Critchfield is a mathematical physicist whose main work has been in theories and investigations of nuclear reactions and forces, nuclear theory and stellar energy.

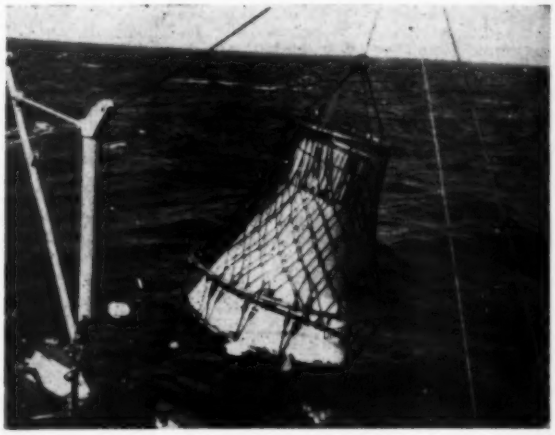
Following a report in the U.S. magazine *Science Trends* that a satellite launched from an F4D Skyray in flight had been in orbit for more than a year, an official denial that orbit had been achieved was issued by the U.S. Navy. It was stated, however, that the Service had tried to place a small satellite in orbit using an air-launched solid-propellant rocket (by an unspecified aircraft), but the attempt was unsuccessful. No further attempts of this nature are planned by the U.S. Navy.

September contracts signed by the National Aeronautics and Space Administration include $2 million to Bendix Radio Division of Bendix Aviation Corp. for the operation of Minitrack stations during 1960; $140,000 to Minneapolis-Honeywell Regulator Co. for fabrication of a guidance and control system for Scout; and $100,000 to Pratt & Whitney Division of United Aircraft Corp. for investigation of "heat-transfer potentialities of a number of materials in a near-vacuum under extremely high temperatures that would be encountered in a nuclear-electric generating system."

The use of a "parking orbit" technique for lunar and interplanetary missions was suggested by Jet Propulsion Laboratory scientists at Langley Research Centre, Virginia, last month. This would involve an orbital coasting period after first-stage burn-out, in order to locate the vehicle at a predetermined position for second-stage ignition. It has been suggested that the use of this technique could obviate the need for an equatorial launching site.

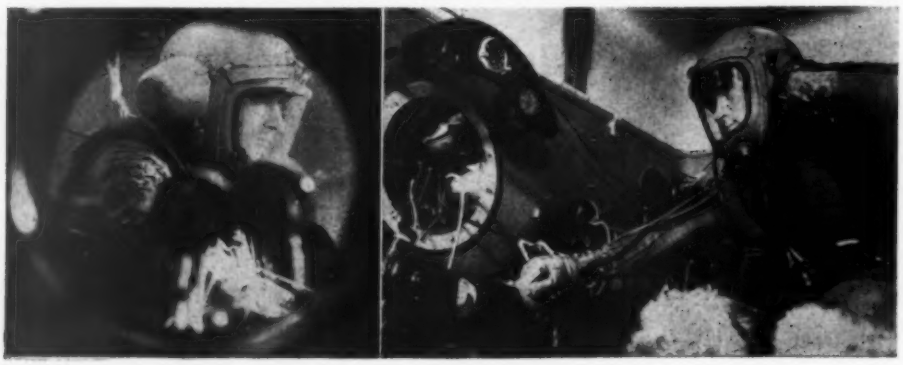
It is announced by the Bulova Watch Co. Inc., that their research laboratories are engaged in the development of the warhead safety and arming device for the U.S. Navy Corvus missile. An unusual feature of the design is that the entire cycle of operations may be performed in the laboratory before launching and then the system may be automatically returned to the safety phase without dismantling. Bulova state that their warhead systems are aimed at a safety failure rate of less than one in a million and arming and operating reliability better than 99.95 per cent.

Left, the Little Joe launched on November 4 in a test (reported on the previous page) of the Project Mercury capsule-escape system. At a height of 33,000ft the boilerplate capsule was separated from the booster, reaching 35,000ft before jettisoning of the escape tower, followed by parachute descent into the Atlantic. Recovery of the capsule by the U.S.N. salvage ship "Preserver," illustrated below, took place 45 min after launch



At the second world congress of aviation and space medicine in Rome last month, it was stated that both Russian and U.S. astronauts had reached the stage of being ready for spaceflight—if the appropriate rocket vehicles were available. The speakers were Mr. Andrei Kouznetsov of the Soviet Academy of Science, and Dr. Seigfried Gerathewohl of the Bio-Astronautic Research Office of the U.S. Army Ballistic Missile Agency. Dr. Gerathewohl said the Project Mercury astronauts were ready for sub-orbital or short orbital flights. He also complained that Russia had not provided "important information" concerning the dog Laika carried in Sputnik 2.

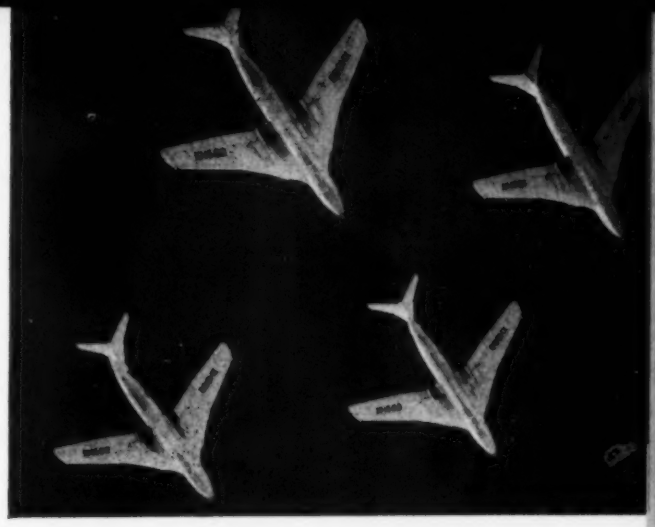
Presenting a paper *Atoms and Space* before the Atomic Industrial Forum in Washington on November 3, Dr. Hugh L. Dryden, deputy administrator of NASA, said that the potentialities of the use of nuclear energy in space exploration were very great, both for primary propulsive power and for auxiliary power. Certain tasks, involving large payloads accelerated to high velocities for deep space missions, could not in fact be accomplished by any other practicable means. Nuclear energy would probably first find space application in auxiliary power systems within the next decade, and these same systems would find use in electrical propulsion later, perhaps also within the next decade. A practicable nuclear rocket would probably be demonstrated toward the end of this period, possibly as an upper stage of an interplanetary probe, the reactor being started after escape velocity had been reached.



Two further photographs of Russian preparations for manned spaceflight. They show space test pilot Gennady Mikhailov during a simulated high-altitude flight at a test laboratory in Moscow. On the left, Mikhailov is seen through the observation window from outside the pressure chamber, the interior of which is pictured on the right. The two furry objects in the foreground are not canine test subjects, but the knees of Mikhailov's pressure suit

SERVICE AVIATION

Royal Air Forces and Naval Flying News



Handley Page Victors of No. XV Sqn., based at R.A.F. Cottesmore, seen in the first formation of four flown by aircraft of this type

Record-breaking Return

AN Avro Vulcan of No. 617 Sqn., homeward-bound to Scampton on the last leg of a round-the-world tour, made a record crossing of the Atlantic from Canada in 2 hr 49 min (coast-to-coast) on November 8. Only Vulcans have made this crossing in under three hours, and this latest time was ten minutes under that achieved by another Vulcan of the same squadron six months ago. The captain was S/L. A. A. Smailes and the A.O.C. No. 1 Group, A.V-M. J. G. Davis, flew as co-pilot. With other R.A.F. aircraft, the Vulcan had recently been participating in ceremonies in New Zealand marking the opening of Rongotai Airport at Wellington.

Tactical Transport Group

A SPECIALIST tactical transport group is shortly to be established in R.A.F. Transport Command. Its function will be to plan and control all tactical transport operations, particularly those concerned with Army support. The commander of the group is to have air vice-marshal rank; some posts will be specifically allotted to Army officers; the new formation's title is to be No. 38 Group (a name famous for wartime airborne support operations); and its headquarters will be located close to those of Transport Command and of the Army Strategic Reserve.

In making this announcement last week, Air Ministry said that the new group would have available to it "an expanding force of tactical and short-range aircraft coming into service," while the build-up of the Britannia force in the strategic element of Transport Command would enable the Hastings and Beverleys to undertake more completely their function of tactical transport.

The original No. 38 Group was formed in October 1943, but had its origins in 1940 when plans were first made to train an airborne force. It took part in all major operations after D-Day and in July 1945 was transferred to Transport Command.

Second Time Lucky

PILOT of a Sea Hawk which landed successfully without an arrester hook on H.M.S. *Eagle* last February, Lt. N. G. Grier-Rees had another stroke of good fortune on Tuesday last week, when he ejected from a Scimitar over the Scottish mountains. The former incident, believed to be the first emergency landing made into a nylon rope barrier, was described in *Flight* for March 20 (page 379); in his more recent exploit Lt. Grier-Rees left his aircraft at about 20,000ft and came down through cloud onto a snow-covered 2,500ft-high peak near Callander in Perthshire. He had to walk about 13 miles before reaching a farmhouse where he got assistance and telephoned to his station, R.N.A.S. Lossiemouth. He damaged his left arm and had a torn ligament in his leg, but an exposure suit he was wearing helped to keep out the cold.

A Flying Future

THERE is still a worthwhile flying career in the Royal Air Force of the future, particularly for university graduates, who could be expected to reach high rank. This was the message the Air Member for Supply and Organization, Air Chief Marshal Sir Walter Dawson, had for Nottingham University Air Squadron members when he attended their annual dinner on October 29. Among other senior R.A.F. guests were A.V-M. H. A. V. Hogan, Flying Training Command S.A.S.O.; G/C. K. S. Batchelor, S.A.S.O. at No. 23 Group; and G/C. J. H. L. Blount, commanding officer of R.A.F. Syerston, where the dinner was held.

Among academic guests were Mr. B. L. Hallward, Vice-Chancellor of Nottingham University, and the Principal of Loughborough College, Dr. H. L. Haslegrave. The Vice-Chancellor replied to the toast of "The Guests," proposed by the squadron's commanding officer, S/L. H. S. Horth; and Sir Walter Dawson's toast—"The Squadron"—was replied to by Cdt. Plt. W. G. Gevaux.

IN BRIEF

Admiral Sir Walter Couchman, Flag Officer Air (Home), opened a new accommodation block for petty officers, which has cost £180,000, at R.N.A.S. Lee-on-Solent on November 11.

* * *

All Comet and Britannia aircraft of Nos. 216 and 99 Squadrons at R.A.F. Lyneham are to be named after stars and constellations.

* * *

A plaque commemorating the achievements of No. 600 (City of London) Sqn. during the Second World War is to be installed at the 600 Sqn. Flying Group premises at Biggin Hill airfield.

* * *

The head of Pericles, symbol of modern Greece, has been painted on the tailplane of the Javelin of W/C. Norman Poole, C.O. of No. 33 Sqn. The squadron returned to Middleton St. George last Friday after a six-week training detachment in Cyprus, which included a goodwill visit to Greece (*Flight*, October 23).

Sir Hugh Foot, Governor of Cyprus, seen (left) with G/C. A. H. Humphrey, station commander at R.A.F. Akrotiri, after investing him recently with the insignia of the C.B. In the centre is Mrs. Humphrey

A.V-M. J. G. Davis, A.O.C. No. 1 Group (right), receiving from Mr. John Gray of Avro a silver model Vulcan to mark the Atlantic crossing referred to above. Centre is G/C. S. P. Coulson, Scampton's C.O.

AIR COMMERCE

COMETS AHEAD OF SCHEDULE

WHEN de Havilland delivered the first Comet 4 to B.O.A.C. on September 30, 1958, they did so exactly on the contract date. It may be recalled that, for good measure, a second Comet 4 —not due till a month later—was handed over at the same time.

It was the same story when, last Monday, D.H. delivered B.E.A.'s first Comet 4B (photograph: page 566). Contract date was January 1, 1960; this was thus beaten by six weeks. For good measure a second 4B was handed over at the same time, ten weeks ahead of de Havilland's contract with the Corporation. All six of the original contract will be delivered by April 1.

An article on B.E.A.'s Comet 4B plans appeared in *Flight* for November 6.

FRIENDSHIPS FOR NEW ZEALAND . . .

IN a joint announcement last week Fokker and Sir Leonard Isitt, chairman of New Zealand Airways Corporation, announced that the New Zealand airline had placed an order for four Friendships for delivery in the second half of 1960. An option has also been placed on an additional seven.

The order is clearly a disappointment for the British aircraft industry, and particularly for Handley Page, who were demonstrating a Dart Herald in New Zealand at the time the order was placed. Fokker say that the decision was made against strong competition and the final choice was the result of "very favourable operational experience gained by the many airline operators . . . which are already using F-27s." This latest order in a market which, contrary to some belief, has never in practice applied Imperial preference, brings to a total of 28 the foreign-built airliners which have been ordered by Australia and New Zealand in recent years. They are made up as follows: *Boeing 707-120s:* Qantas, 7; *Lockheed Electras:* Ansett-A.N.A., 2; T.A.A., 2; T.E.A.L., 3; Qantas, 4. *Fokker Friendships:* Ansett-A.N.A., 6; T.A.A., 7; Mac.Robertson-Miller, 2; Australian Department of Civil Aviation, 2; N.Z.N.A.C., 4.

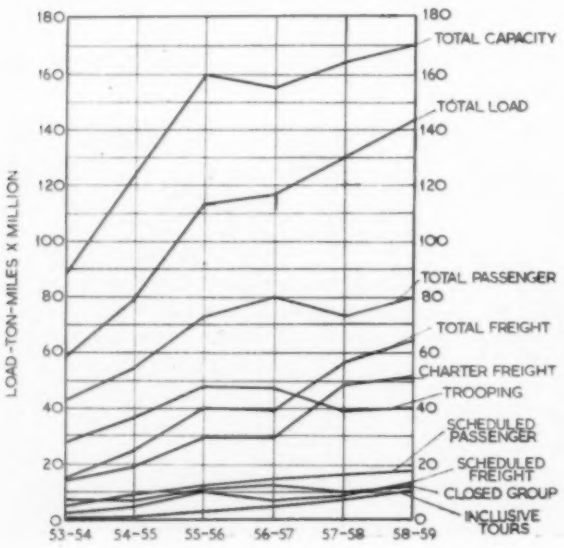
Optimists can take some comfort in the fact that—according to a figure given by Sir Leonard Isitt—the Friendships have a 63 per cent British content. And N.Z.N.A.C. have also placed a further order for a Viscount 807 to bring their total Viscount fleet to four.

. . . BUT ELANDS FOR ALLEGHENY

IN the face of very keen competition from Allison, Napier Engines Inc., Napier's wholly-owned subsidiary in the U.S., have secured a substantial order for Eland NEl.6 engines from Allegheny Airlines. Napier will re-engine and supply engine spares for five Allegheny Convairs and the airline has taken an option on sufficient engines for another ten aircraft. The number of engines on firm order is 15 and if the option is exercised the total will be 45, at an ex-works price of about £38,000 each. As conversion cost of each aircraft is about £140,000, the value of the order (for 15 aircraft) would be about £3 million.

Conversion of the Convair 340/440s (which Allegheny are to acquire specially) will be undertaken in the United States by contractors to Napier Inc., and the aircraft should be ready for service before next autumn. They will be equipped with de Havilland propellers.

This is the first airline order for Convair 540s and it represents a substantial breakthrough for Napier, who have invested equally with the Government many millions in Eland development. A note on Allegheny's trial operation of a Convair 540 leased from Napier Inc. appeared in *Flight*, October 23, page 443.



This "Flight" graph breaks down into the various fields of activity the growth of Britain's independents over the past five years. A further note on B.I.A.T.A.'s 1958-59 report is on page 574; it is possible that the "total load" curve since 1954-55 is not as steep as it appears to be

THE SHEIKH SEES THE MINISTER

FOR the second time in less than a month Sheikh Najib Alamuddin, chairman of Middle East Airlines, has visited London to discuss the relationship of his airline with B.O.A.C. Last week he saw the Minister of Aviation, Mr. Duncan Sandys.

Of present concern to the Sheikh is M.E.A.'s re-equipment programme. It is probable that eight aircraft will be ordered from a choice of Comet 4s, Britannias or Vanguards, with the Vanguard the most likely possibility. M.E.A. have already made it clear that they are dissatisfied with their past relationship with B.O.A.C. and it now seems that the Sheikh is criticizing the arrangement under which M.E.A. must deal with B.O.A.C. Associated Companies rather than direct with the Corporation. Although the Corporation's annual report was prepared before matters between the two airlines came to a head, there can be little doubt that the criticism of M.E.A. contained in the report cannot have improved the relationship of the associate to the parent Corporation.

The most likely interpretation of the Sheikh's visit to the Minister of Aviation is that he hopes to bring ministerial pressure to bear on the Corporation to revise the agreement between the two companies in the context of B.O.A.C.'s favourable traffic rights in the Lebanon, M.E.A.'s improved trading position, and the formation of Air Arab.

THAT 707 INCIDENT

LACK of attention by the co-pilot was given as the main reason for the near-accident to the 707 which lost 29,000ft and suffered "extensive structural damage" over the North Atlantic last February. The C.A.B. report on the incident says that the co-pilot, Capt. Samuel Peters, was working at some calculations with the 707 flying on autopilot when he felt the aircraft buffet. He glanced up and saw stars moving counter-clockwise, "indicating that the 707 was in a nose-down spiral about to roll over on its back."

"Everyone in the cockpit," continues the report, "was seriously affected by the g forces." Capt. Waldo Lynch, the senior pilot, returned to his seat with considerable difficulty, pulled the power levers to the idle position and asked another crew member to hold him in his seat. At 8,000ft he pulled back on the control column and at 6,000ft there was "terrific, violent pounding or buffeting which lasted a couple of seconds, then the aircraft ceased to descend and began a fairly steep climb." Had the co-pilot paid proper attention to the cockpit instruments, says the report, he could have taken the controls after the automatic pilot disengaged and prevented the dive.

The F.A.A. grounded Peters, a supervisory captain, for six months, and he has since been retired on pension. Capt. Lynch, who was then and is still PanAm's vice-president for communications, was fined £715 because he was not in the cockpit at the time of the incident.

CAMBRIAN PRESS AHEAD

THE diminution of services subsequent to Cambrian's poor year in 1958, after which they had to "retrench and reorganize," now seems to be passing. At the beginning of this month the Cardiff - Bristol - Manchester - Belfast services were re-opened and next April services will again be offered from Swansea to the Channel Islands. In part, this will answer criticisms that Cambrian were not supporting Swansea Airport. That support could only be given if the traffic was there was emphasized by W/C. L. B. Elwin, Cambrian's managing director, when he announced the re-opened service. "If we have this," he said, "we shall be in a position to continue our planned expansion . . . in this part of Britain."

Another new service is to start next summer. This will be once a week from Cardiff - Bristol to Dinard at a reduced fare of £12.

AIR COMMERCE . . .

HOW TO BECOME AN AIRLINE PILOT

FROM any point of view the new College of Air Training is going to be an expensive business. In full operation its running costs will be about £400,000 a year; this will demand substantial contributions from the British airlines, from the Exchequer and from the pilots under training.

It is estimated that it will cost, on average, about £4,000 to train each cadet to the standard that is now required of an embryo airline pilot. The initial cost will be even higher. Through the Ministry of Education the Exchequer is granting £1,000 towards the training of each pilot; the cadet will have to pay £380 per year in fees, for the two years of the course, and the sponsoring airlines will find the rest, although after a pilot is trained he will have to repay to the Corporations from his earnings £1,000 over an unspecified number of years. So altogether, every cadet who passes through the school will have to contribute £1,760 towards his training, although a local-authority grant may meet the annual fees. But a grant depends upon a means test, and parents who are anxious to see their sons enter flying as a profession will certainly not be doing so because the entry fee is low.

Introducing the scheme last week, the first chairman of the Board of Governors, Capt. J. W. G. James, flight operations manager of B.E.A., said that he thought and hoped that most of those trained by the Corporations would remain in their service for some while—long enough at least to repay the quite substantial debt with which they start their professional career. Yet by any realistic reckoning the period of repayment cannot be less than five years and the burden for the pilot will be quite a heavy one.

On the other hand, the eventual rewards are high; a fully fledged jet transport captain earns over £4,000 a year. This must weigh in the balance when a career has to be decided, but it is "I want to be an airline pilot" enthusiasm rather than the thought of an ascending salary scale that makes some initial hardship worthwhile, and B.O.A.C. say that they have received 1,000 inquiries from potential pilots in the past year. Further applications from both Corporations can be taken from the end of November and the first course will start in September 1960.

Academic requirements are passes in five different subjects in the General Certificate of Education with two at advanced level, but airline sponsorship will only be given to prospective pilots who can pass the aptitude, fitness and intelligence tests. Age limits at entry are 18-20, although candidates with university degrees can be accepted up to the age of 23.

Men with these qualifications are in demand elsewhere and the Board of Governors are a little uncertain as to whether the scheme will attract sufficient numbers to fill the initial requirement of 50 trainees per year for B.O.A.C., another 50 for B.E.A. and perhaps another 30 for the independents.

Flying training will be on Chipmunks and Oxfords, but the possibility of acquiring more advanced trainers for the college is under consideration. It seems obviously desirable that sooner or later a jet trainer should be introduced. Apart from providing a commercial pilot's licence and an instrument rating, much emphasis is to be placed upon "liberal studies" and to academic tuition towards the airline navigator's licence; it is the intention to turn out pilots with an all-round training.

To establish the college the entire site and buildings of Air Service Training at Hamble, Hants, have been taken over. This spells the end of A.S.T. as such, but Air Marshal Sir Hugh Walmsley, who has been Principal of the college for the past seven years, will continue to hold this position as a member of the Board of Governors of the College

Unlike A.S.T., which recently has been mainly concerned with the training of overseas students (the cost then was about £2,500 each for a 12-18 months' course, depending upon the pupil's ability), the College of Air Training will at first only be concerned with cadets who are sponsored by B.O.A.C., by B.E.A. or by the British Independent Airlines Association (the latter have been invited to nominate a Governor, although they have not yet done so).

No arrangements, for example, have been made for training pilots of B.O.A.C.'s associates, but Capt. James said last week that the training of pilots for Commonwealth and other overseas airlines was certainly contemplated, although in this case the airline concerned would have to meet the full cost of training.

Formation of the new college does not necessarily mean that employment with the Corporations is closed to ex-Service pilots or those who have trained for their commercial licences at other schools, but it is only to be expected that the Corporations will give preference to those pilots whom they have sponsored from the start.

Apart from Capt. James, other members of the Board are: Capt. T. H. Farnsworth, chief of flight operations, B.O.A.C. (deputy chairman); Dr. K. G. Bergin, director of personnel and medical services, B.O.A.C.; Capt. W. B. Houston, training manager flight operations, B.O.A.C.; Mr. R. A. Spencer, chief accountant, B.E.A.; Mr. J. Vivian, personnel and training manager, flight operations, B.E.A.; Mr. G. V. Hole, under secretary, M.o.A.; Mr. J. H. Brook, assistant secretary, Further Education Branch, Ministry of Education; and Mr. R. M. Marsh, chief education officer, Hampshire County Council.

DC-8 PERFORMANCE

THOSE who refer to DC-8 performance in the special supplement to this issue of *Flight* will find that no figures are available —at the special request of the manufacturer. In reply to *Flight's* routine questionnaire, which was sent to the constructors of all aircraft included in this supplement, Douglas replied: "After due consideration of all the factors we have elected to omit detailed performance data on the DC-8 for the present. None of the figures have been certified but most of them will have been demonstrated during the useful life of the publication. We do not care to have inaccurate or estimated data in print which might be at variance from the ultimately established performance." This ruling applied as much to the JT3 domestic DC-8, which received its Certificate of Airworthiness (which calls for a full flight manual) on August 31, as to the as yet uncertified overwater version.

Reports in the American Press suggest that, notwithstanding the contrary claim of United Air Lines advertisements, the DC-8 is a slower aircraft than the Boeing 707. According to *Aviation Week*, "an unexpected 3-10 kt drag penalty" on JT3-powered DC-8s under normal cruise conditions has arisen, and Douglas are working to eliminate it. A change to the contour of the engine pylons is possible, but it is reported that Douglas will try also upper-wing vortex generators which, it is claimed, give a 7 kt improvement to the Boeing 707 performance.

Meanwhile, the president of American Airlines, Mr. C. R. Smith, told the New York Society of Security Analysts recently that the DC-8 should be "a very fine airplane," but that if his company had to decide between one or the other again it would still order the 707. The 707 aircraft, he said, was faster—considerably more than the 10 m.p.h. Douglas would concede—because the DC-8 was larger, though carrying no more passengers, weighed a little more, and had less wing sweepback. Given comparable powerplants, Mr. Smith considered, the 707 would always be a faster aircraft.

Despite all this it is remarkable that Boeing have done to the 720 wing what Douglas did from the earliest stages of DC-8 design. They have modified the contour between the fuselage and the inner pylon to reduce positive camber and to reduce t/c ratio, thus improving compressibility characteristics by delaying drag-rise. It is claimed that limiting Mach number on the Boeing 720 is increased from 0.88 to 0.90. This modification was made to catch up with Convair rather than with Douglas; now it seems that the Convair 600 has drawn ahead thanks to the area ruling effect of the wing shock pods.

Behind the tail of a Comet 4B is one of the first B.E.A. Viscounts to be pictured in the Corporation's new colour scheme. When the Comets are serving Moscow from April 1 next year, we hope to find another picture to caption "B.E.A. in Red Square"

On November 7 this Executair Widgeon operated a proving flight on part of the route Portsmouth - Ryde - Sandown/Shanklin - Newport - Cowes - Southampton, over which Inter-City Airways have applied to operate a scheduled service

AIR COMMERCE . . .

POSTSCRIPT TO B.I.A.T.A.'s REPORT

THE statistics published by B.I.A.T.A., whose 1958-59 report was reviewed last week (see also graph, page 572), should be considered in the light of two important qualifications:—

(1) The statistics do not include the traffic carried by such important non-B.I.A.T.A. members as Tradair, Overseas, Air Safaris and, until last year, Independent; and

(2) The load ton-mile figures appear to be on the high side, possibly because l.t.m.s and c.t.m.s are treated as synonymous on certain major long-term freight contracts.

Bearing these qualifications in mind it is significant that since 1956 the independents as a whole have grown less rapidly than either of the two Corporations. Three years ago they accounted for about a third of Britain's total air traffic; the proportion has now declined to about one quarter. Cancellation of Airwork's transatlantic freight service at the end of 1955 was one reason for this. Even so, in subsequent years the Corporations grew faster than did the independents.

By going back to the pre-1953 era it is possible for the independents' adversaries to show that these companies have been taking business away from the Corporations. Since that time, for instance, the independents' scheduled passenger traffic has trebled. Yet the fact is that this category of traffic has been virtually static for the past three years. Inclusive tour traffic has, of course, been rising steadily, and closed group and *ad hoc* charter flights have over the past three years shown a small increase. But this expansion has been more than offset by the reduction in trooping.

The overall position, then, is that the independents' total passenger traffic over the past two or three years has been more or less static. In contrast, freight traffic is shown as having increased rapidly—fourfold over the past five years. Unfortunately, some of this growth may be fictitious, since it appears from an analysis of the figures that loads on a number of long-term freight contracts are reported in terms of the capacity available. The probable situation is that freight traffic—in terms of actual loads carried—rose to a peak in 1955 with Airwork's Atlantic service, then dropped smartly in the following year, and has subsequently risen to slightly above the 1955 level.

In summary it can be said that thanks to the freight recession in 1956 and the passenger recession in 1958, the independents' total traffic carried has increased by less than 10 per cent since 1955, assuming that total load-ton miles are indeed inflated by some c.t.m.s. This is a very different picture from that sometimes painted by the independents' opponents. [Leading article: page 565.]

BREVITIES

The maiden flight of the Canadair CL-44D (four Rolls-Royce Tynes) was made on November 15. An assessment of general handling characteristics was made in the course of a two-hour flight, and the aircraft was stalled in all configurations. The pilot's report is said to have been "extremely enthusiastic." The CL-44D is described on page 587 and a cutaway drawing is on pages 588-589.

Five of B.O.A.C.'s Comet 4s have now been equipped with thrust reversers, which were incorporated as standard on B.E.A.'s recently delivered Comet 4Bs.

Next summer B.E.A. are to operate 60-70 seat Viscounts on Channel Islands services and will offer mid-week fare reductions averaging about seven per cent on monthly return fares.

The Iraqi Government are forming a committee to hold discussions with B.O.A.C., starting on November 25, on co-operation between Iraqi Airways and the Corporation.

A new runway at Orly was inaugurated on November 6. It is 3,300 metres long and built on bridges over the road into Paris. The new terminal building and hotel will be opened next year.

Silver City's Manston-based Hermes, all five now in Silver City markings though owned by Britavia, have been integrated into the Southern Passenger Division. Mr. R. M. Hackney has been appointed base manager, Manston, and Mr. J. R. Dixon operations superintendent.

Master Air Pilot's certificates have been awarded by the Guild of Air Pilots and Air Navigators to captains L. Arthur, B.O.A.C.; K. C. Deadman, B.O.A.C.; F. Fischer, T.A.A.; C. C. Forman, T.A.A.; and N. Rodnight, Hunting-Clan Air Transport.

Aircraft Propulsion—Present and Future is the title of a G.A.P.A.N. lecture to be given by Mr. J. A. Barnes at the Royal Society of Arts, London, W.C.2, at 6.30 p.m., on December 1. Tickets from the secretary of the Guild, 14 South Street, Park Lane, W.1.

Delivery of the first Boeing 707 to B.O.A.C., expected at the end of December, may be put back until the end of January. Test flights by the A.R.B.'s pilots, previously due to start next week, will not now take place before the New Year. The start of transatlantic services is not expected to be delayed.

Tasman Empire Airways are to purchase a 50 per cent interest in Fiji Airways for about £82,000. Fiji operates two Herons and three Drovers over a network of 560 miles. The purchase implies agreement between Australia and New Zealand to hold equal shares in Fiji and for Qantas and T.E.A.L. to operate services in co-operation.

Speaking in Glasgow on November 7 about the possibility of Abbotsinch replacing Renfrew as Glasgow's municipal airport (*Flight*, November 6, page 491) Lord Douglas, chairman of B.E.A., said that "no decision has been taken nor is one likely for some time. . . . From a flying point of view it is much better." A report of a survey made at Abbotsinch for the M.T.C.A. is being considered by Mr. Duncan Sandys, Minister of Aviation.

B.E.A.'s two-year-old decision not to include a flight engineer in Comet 4B three-pilot crews has been opposed by the International Transport Workers Federation.

Mr. Basil Smallpeice, managing director of B.O.A.C., is visiting Canada and India to pursue the idea of Commonwealth pooling agreements. Discussions in Canada were with T.C.A. and in India will be with Air-India and Qantas.

A new terminal building capable of dealing with about 300 passengers an hour is to be constructed at Hurn and will be completed between 1962 and 1965. The £300,000 required for the first stage of construction will be supplied by the M.o.A.

PanAm are introducing their average fare-cuts of 50 per cent on freight rates between the U.S. and the Far East on January 1, 1960, when the commodity rating will be simplified. The airline is also examining the possibility of a service across the South Pole to Australia; one difficulty would be the necessity of a jet airfield in the Antarctic.

Boeing's new public relations manager in Europe, with headquarters in London, is Robert S. Mansfield. He succeeds Percy Blackburn and will take up his appointment before the New Year. See also page 576

Los Angeles Airways have ordered five Sikorsky S-61s (two G.E.T58) for service in 1960-61 at a price of about £232,000 each.

A new East Africa Lodge of the Guild of Air Traffic Control Officers is to be inaugurated in Nairobi on November 24. Other Lodges in Africa are in Salisbury and in Kano.

Since the Commercial Aircraft of the World Supplement to this issue went to press it has been made clear that the Italian industry will participate in the Nord Transall project. Three prototypes are to be constructed, partly in France and partly in Germany. The first will be assembled and tested in France and the other two in Germany. The word Transall is an abbreviation of Transport Alliance.

The F.A.A. have ruled that jet transports on flights outside the United States must carry enough fuel to fulfil these requirements: (1) approach scheduled destination and climb back to cruising altitude; (2) fly to the most distant airport in the alternate landing area; and (3) fly in a holding pattern at 1,500ft for half an hour before landing at the alternate. Additionally, the aircraft must be able to cruise for an additional period equal to 10 per cent of total flight time from its original take-off for the destination airport. Where no alternate is available the aircraft must carry enough fuel for two hours' cruising beyond the original destination.

FLIGHT SYSTEM SURVEY

Right, a Russian approach control console shown in New York recently. Behind the telephone appear to be wind direction and strength dials and, beyond, the six speakers, search, centre-line and glide-path P.A.R. displays. A meter next to the search scope possibly shows height and other meters show centre-line and glide-path displacement. A plastic cursor defines the centre-line. The hooded scope is not identified. Search and centre-line displays are arranged for one operator

Decca Trials in the Channel Islands

AIR traffic in the Channel Islands control zone reaches high density during the summer holiday season and is increasing. Control, based mostly on beacons located on various islands, is having a restrictive effect on the flow of traffic and the Ministry of Aviation is therefore considering setting up Airway Blue 26 between Hastings and Jersey in order to provide an additional route.

The Decca Navigator Co. was yesterday beginning a series of demonstrations designed to show that the South-West British Chain, with its red slave transmitter on Jersey, can provide additional flight-paths and holding patterns in the control zone without the need for additional beacons or facilities on the ground. The company also points out that Decca is the only navaid which can accurately cover Airway Blue 26.

Mandatory Weather Radar

VIGOROUS reactions have already resulted from the Federal Aviation Agency's proposal to make weather radar mandatory for all bad-weather airline flights in the U.S. The Air Transport Association has retaliated on behalf of the airlines by saying that 63 incidents attributed by F.A.A. to lack of weather radar could not in fact be ascribed to this cause. It is pointed out, for instance, that weather radar will not detect hail and that thunderstorm weather was not a significant factor in many areas of airline operation. While recognizing that the equipment was important where the airliner regularly flew at speeds while above recommended turbulence-penetration speeds, A.T.A. claimed that it was less useful for slower aircraft and that it was undesirable to let crews rely too much on it.

Yet the principal A.T.A. resistance seems to be based on economic considerations. Operators would require at least three years to equip all their aircraft and considerable maintenance facilities would have to be distributed along the route if flights in poor weather with unservicable weather radar were to be forbidden. A.T.A claimed that the weight of present radar weather equipment forbade duplicate installations. (Incidentally, the Ekco E.190 light-weight weather radar could be duplicated at a total weight of about 100 lb.)

It seems likely that the proposed F.A.A. regulation will be very considerably modified—but not abandoned.

Lockheed LOCTRACS

THE Electronics and Avionics Division of Lockheed has proposed to F.A.A. an automatic position-reporting system for airline use called LOCTRACS and based on pulsed airborne transmitters and groups of four ground-based receivers. Position of the aircraft is derived by measuring the arrival time of the signals and plotting position in traffic control centres. Receiver-to-centre transmission would be by microwave link or land-line and time delays involved at this stage would be cancelled out by special equipment.

The sectors would be from one mile to one-sixth of a mile square; and coded transmissions, giving identification and height information, could be received from as many as 1,000 aircraft in each sector. The system could provide a collision-warning service after automatic plotting in the centres. Some 250 LOCTRACS sectors would cover all major U.S. airways, or 700 sectors would cover the 48 continental states and also give high-density coverage near major terminals. Cost is estimated at between $310m and $700m. F.A.A. is investigating LOCTRACS, but has placed no contract.

Draken Simulators

SEVEN weapon-system simulators for the Saab J-35 Draken have been bought by the Royal Swedish Air Board from Curtiss-Wright Corp. They will have a moving base and will reproduce flight vibration and noise. In addition to behaviour of aircraft and engine, the new equipment will simulate all relevant tactical situations and it will include a scoring device for the assessment of interceptions.

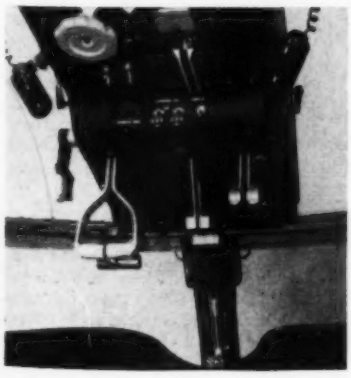
.....

Eleven Doppler radars have been ordered from Collins Radio Co. for T.C.A.'s six DC-8s. Total cost is $231,000 and delivery is to begin in January, in preparation for the company's inaugural transatlantic service on June 1. T.C.A. has an option for ten more units.

A $247,951 contract has been placed by F.A.A. with I.B.M. Corp. for continuation of fast-time computer studies of traffic delays in the New York area. This work is to be related with that of the large, real-time traffic simulator now being installed at NAFEC, Atlantic City.

Bendix 21 series V.H.F. communications and navigation radio has been ordered by the Royal Swedish Air Board for installation in R.S.A.F. Pembrokes and other types. Further 21 series equipment worth almost $1m has also been ordered by the West German Air Force.

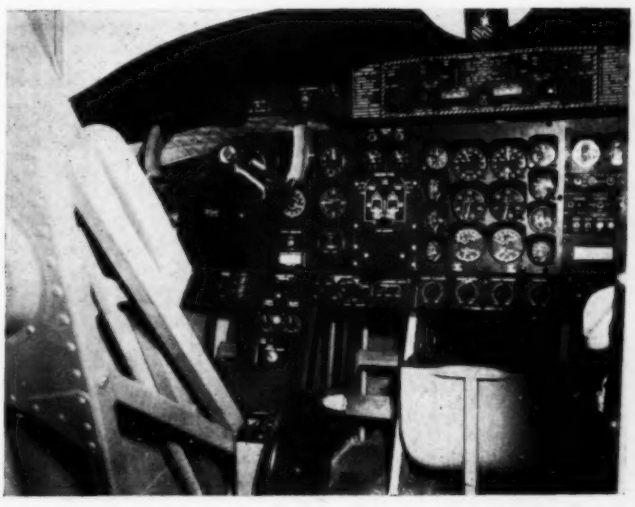
Below, roof-mounted controls in the Caribou include gear lever, throttles, control lock, pitch and mixture controls on the forward panel with aileron trim indicator, landing and taxi light switches immediately aft. Nearest camera are rudder trim-wheel, magneto switches and flap lever recessed in the panel. Emergency brake levers and the standby compass are located in the windscreen pillar



CARIBOU SYSTEMS

"Flight" photographs

Right, the Caribou cockpit showing fuel, engine and electrical panels surmounted by emergencies panel. All radio controls are on the drawer-type console shown here pushed out of the way. Air test report: p. 568



Straight and Level

A FEW eyebrows were raised by something Mr. Duncan Sandys said on the occasion of his first public appearance as Minister of Aviation. At the annual dinner of the British Independent Air Transport Association in London last week he told the story of how, flying in cloud over Switzerland back in 1933, his Gipsy Moth got into a spin. "I suddenly saw pine trees and mountains going round and round in front of me," he said, "and I remembered not to do what you are told not to do in a spin—I pulled the stick back . . ."

Sandys the youthful aviator did what he had been advised not to do—and he got away with it. Let's hope that Sandys the Aviation Minister is as lucky.

● And a few brows were furrowed by something else he said. He suggested that there were too many independents. Those who joined forces, he said in effect, would be the ones who would get the new services.

Heaven forbid that the Government try to apply shotgun-wedding pressures in the private air transport industry as they have done, with some justification, in the aircraft industry. The independents, like the manufacturers, are of course contractors to the Government. Half their overall revenue is derived from Government departments. But I question the right of a Government to make amalgamation a condition of entry into scheduled services, and I believe that the natural pressures of commerce should determine the structure of the independent airline industry, not Government pressures.

"This is, of course, entirely your affair," remarked Mr. Sandys, "and I hope nobody will think that I am trying to drop any hints!" (The exclamation mark comes from the official Ministry transcript of his speech.)

* * *

It is indeed their affair, and here are three points Mr. Sandys might consider before he drops any more hints: (1) The bigger independents already have the resources; they just need sound investments for them. (2) Forced mergers result not only in bad morale, and all this means in reduced operational efficiency, but they result also in monopolistic tendencies which defeat the independent spirit. (3) This spirit, as exemplified by the small, efficient, well run airline with the personal touch, has much to offer British air transport—perhaps, most of all, low costs.

A policy which destroys the independence of these operators would destroy everything for which private-enterprise air transport stands. Which would be an odd thing for a Tory Government to do.

● I have often wondered why Geneva has become the European base of the American aircraft industry. Boeing, Douglas, Lockheed, United Aircraft and others all have commercial and engineering representatives based in that city. It may be something to do with the fact that Geneva has some good American schools for the children; it may be something to do with the fact that Switzerland is a neutral country; it may even be something to do with the fact that Geneva is a very pleasant and agreeable city.

Thus I find it quite interesting that Boeing should now appoint a European public relations manager (see page 574) whose headquarters will be in London. Boeing say: "It has become increasingly apparent that London, as a focal point of European and Commonwealth news handling, is a logical centre for our public relations effort."

Could this be the first sign of a geographical shift in the American industry's representation in Europe?

● An historic occasion at *Flight*'s offices was the arrival of the first press release from the new Ministry of Aviation. Something of moment obviously, in these days of change and challenge. An edict on Colonial cabotage? Rationalization of the Corporations? The relationship between the Bristol 188, the TSR.2 and the supersonic airliner programme?

No: it was notice of a demonstration of multi-fuel engines at the Fighting Vehicles Research and Development Establishment.

I was still trying to puzzle out what this had to do with aviation when I was sent a copy of a communication a friend had received from the same Ministry:—

"A flight crew member should have a spare set of suitable correcting glasses readily available when exercising the privileges of a licence for which he was assessed as fit subject to suitable correcting glasses being worn."

Answer to first puzzle: Don't know, give up.

Answer to second puzzle: Fly with your spare specs.

● I am always hearing sad tales about the apparent inability of world aircraft manufacturers to keep prices down to the original quoted figures. Many are the unhappy operators who have lived to regret having agreed to escalator terms—known to the industry's cynics as "jack-up clauses."

But perhaps this is characteristic not just of the aircraft manufacturers but of industry as a whole. Take, for instance, the much-publicized new British vessel *Oriana*. Three years ago the cost of this 40,000-ton luxury liner was reckoned to be £10 million; by launching time the other week this figure had climbed to £14 million.

Incidentally, that amount of money spent on jets could have bought a fleet of seven aircraft with an annual passenger-mile capacity equivalent to four times that of the *Oriana*.

● Mr. Peter Masefield, guest of honour at the annual dinner of the D.H. Old Boys' Association on November 7, gave this dictionary definition of the M.o.A.: "Moa: an extinct flightless bird which, like the ostrich, seeks refuge in the sand."

ROGER BACON

From an American reader comes the following revised caption to this picture, which originally appeared in *Flight* of October 9, 1959, page 387: "English amateur-built aircraft in flight, accompanied by customary squadron of government machines assigned to the task of ensuring that it will abide by all regulations imposed by officialdom. If small craft errs, fighters are authorized to leash it and conduct it home to the doghouse."

Commercial Aircraft

OF THE WORLD

On this and the following 45 pages—and in more than 30,000 words of text—*Flight* presents its fourth annual special survey of the world's commercial aircraft.

This year the emphasis is on the operator's point of view. The 170 types and variants described embrace aircraft in service, new transports for which airline orders have been placed, and types which as yet are merely projects. Aircraft of less than about 8,000 lb gross weight, or those in service in very small numbers, have not in general been included. But reference is made to a number of projects that were active last year and which have since been discontinued. An up-to-date order book is given for each new transport.

On pages 600 to 605 will be found a series of new *Flight* drawings illustrating the operational—rather than engineering and structural—features of 11 aircraft. These have been selected because they are in commercial service or because they are directly comparable with aircraft in service. An introductory note to these drawings is given on page 600. Engineering cutaway drawings of nine of these types have previously appeared in our pages, as noted alongside the new drawings. Another eight aircraft which are new and particularly interesting from an engineering standpoint (including the VC.10 and Convair 600) are the subject of double-page *Flight* cutaway drawings, as indexed on page 603.

Aircraft are presented in alphabetical order of manufacturer, but an alphabetical cross-reference index by aircraft name has also been included at the end of the survey on page 621. Previous *Flight* references are listed as appropriate in the text as an aid to more complete descriptions.

The information given has, wherever practicable, been checked by the manufacturer concerned and with a small number of stated exceptions is presented in a standardized form. In the sections "payload accommodation," cabin volume and maximum usable floor area are exclusive of the flight deck; baggage and freight volume is exclusive of the passenger cabin; engine powers are per engine and are quoted for take-off at sea level and in International Standard Atmosphere conditions; and "weight less fuel and payload" is the weight of the aircraft, otherwise ready for service. Balanced field lengths and landing lengths are to current U.S. or British requirements. No performance figures are quoted for the Douglas DC-8, at the manufacturer's own request.

Payload-range curves have not been included, because payload-range performance is here adequately defined by stating range with maximum payload (range A) and range with maximum fuel (range B). Range A is a hypothetical figure implying operation in still air and I.S.A. conditions and with the aircraft cruising at the optimum altitude and airspeed to obtain maximum range with no allowance for reserve fuel. Range B is a similar figure for ultimate range with maximum fuel; corresponding payload and mean cruising speed are also quoted.

This year we have not included manufacturers' cost-range curves; they are not calculated by identical methods and are consequently of limited value, if not actually misleading, for purposes of comparison. Wherever possible basic or used prices have been given.

INDEX BY AIRCRAFT NAME ON PAGE 621

Aerfer Ae 150 project (Rolls-Royce Dart RDa.10s)

AERFER *Industrie Meccaniche Aeronautiche Meridionali Aerfer, Corso Malta 30, Naples, Italy.*

Ae 150 A model of this 35,000 lb transport project, which is to be powered by two 2,660 e.h.p. Rolls-Royce Dart RDa.10s, was displayed at the 1959 Paris Show (see above). It is intended for military use, but the company stresses its commercial applications. No time-scale has been mentioned. Details are given as follows, as complete as have been so far published.

Powerplant: Two Rolls-Royce Dart RDa.10 of 2,660 e.h.p. each, driving Rotol 14ft propellers.

Dimensions: Span, 106ft; length, 79ft; height, 28ft; wing area, 1,238 sq ft.

Weights: Max. take-off, 36,376 lb; landing 33,500 lb; zero fuel, 29,876 lb; capacity payload, 6,614 lb; weight less fuel and payload, 23,262 lb.

Payload accommodation: Cabin volume, 2,130 cu ft; cabin length, 26ft; max. width, 8ft; max. height, 8ft; rear ramp-loading door, 9ft 2in height × 8ft 2in width.

Fuel capacity: 900 Imp. gal.

Performance: Cont. cruising speed, 223 kt (256 m.p.h.) at 16,400ft and 36,376 lb; corres. fuel consumption, 255 Imp. gal/hr; landing distance from 50ft, 600ft; range B (max. fuel), 700 n.m. (805 st.m); corres. payload, 6,614 lb; corres. cruising speed, 232 kt (267 m.p.h.).

AGUSTA *Costruzioni Aeronautiche Giovanni Agusta, Cascina Costa, Gallarate, Milan, Italy.*

A-Z-8 Two versions of this four-engined transport (Alvis Leonides piston engines) are offered, the A-Z-8N and the A-Z-8P, respectively 22 passengers (two abreast) non-pressurized and 30 passengers (two-abreast) pressurized.

The A-Z-8N prototype first flew on June 9, 1958. The type falls into the DC-3 replacement category, and it is offered for military as well as for civil use "where safety, minimum operating cost, and medium range are primary considerations." A small order for the Italian Air Force is possible.

The following data, converted from metric figures, apply to non-pressurized and pressurized versions as denoted by (N) or (P):—

Powerplant: Alvis Leonides 531 or 640 b.h.p. (P), or Leonides 502/5 of 540 b.h.p. (N), driving de Havilland three-blade 9ft model 13250 propellers.

Dimensions: Span, 86ft (P), 83ft 8in (N); length 66ft 10in (P), 63ft 9in (N); height empty, 21ft 8in (P), 21ft 7in (N); wing area, 743 sq ft (P), 719 sq ft (N); aspect ratio, 9.95 (P), 9.78 (N); cabin length, 32ft 3in (P and N); max. cabin width, 7ft 9in (P), 5ft 5in (N); max. cabin height, 6ft (P), 6ft 1in (N); door, 2ft 7in.

Weights: Max. take-off, 26,450 lb (P), 24,900 lb (N); landing, 25,130 lb (P); 23,810 lb (N); zero fuel, 23,700 lb (P), 20,570 lb (N); weight less fuel and payload 17,745 lb (P), 16,200 lb (N); max. payload, 5,950 lb (P), 4,360 lb (N).

Payload accommodation: Cabin, 1,260 cu ft (P), 987 cu ft (N); baggage and freight, 242 cu ft (P), 194 cu ft (N); max. usable floor area, 192 sq ft (P), 168 sq ft (N).

Fuel capacity: 688 Imp. gal (P and N).

Performance: Cont. cruising speed (P), 205 kt (236 m.p.h.) at 10,300ft at 24,250 lb; (N) 198 kt (230 m.p.h.) at 11,300ft at 22,045 lb; corres. specific fuel consumption, 0.55 lb/h.p./hr (P and N); balanced field length, max. take-off weight, over 50ft, sea level, I.S.A., 1,690ft (P), 1,750ft (N); at sea level, I.S.A., +15 deg C, 1,820ft (P), 1,935ft (N); at 5,000ft, I.S.A., 2,230ft (P), 2,310ft (N); max. landing distance, sea level, from 50ft (ILS procedure), 2,360ft (P), 2,280ft (N); range A (max. payload), (P) 778 n.m. (895 st.m.), (N) 1,210 n.m. (1,390 st.m.); range B (max. fuel), (P and N) 1,445 n.m. (1,680 st.m.); corres. payload, (P and N) 18 passengers or 3,680 lb; corres. cruising speed, (P) 201 kt (233 m.p.h.), (N) 196 kt (226 m.p.h.).

AIRCO *The Aircraft Manufacturing Co. Ltd., Great Nast Hyde, Hatfield, Hertfordshire, England.*

Airco D.H.121 The D.H.121 jet airliner is being privately financed and produced by a consortium of British aircraft companies which was formed in January 1958, comprising de Havilland (67½ per cent participation and four directors); Hunting (22½ per cent and two directors), and Fairey (10 per cent and one director).

The D.H.121 is described under de Havilland on page 597. An illustration appears on page 596.

AIRSPEED This company, which designed the AS.57 Ambassador (Elizabethan), was taken over by the de Havilland Aircraft Co. Ltd. in 1948, and was merged with that company in 1951. The Ambassador is described under de Havilland on page 597.

ANTONOV One of the U.S.S.R. State aircraft industry's chief designers, Oleg Konstantinovich Antonov, has given his name to four transport aircraft designs for service with Aeroflot, as follows:—

An-2 The prototype of this ubiquitous single-engined biplane transport flew in 1947, and it is said that more than 2,000 have been built for military and civil use. The standard 8-12 seater is an An-2P, powered by one ASh-62 IR radial engine of 1,000 h.p. Variants are the An-25 (agricultural), An-2V (floatplane, Antonov design number An-6), and An-2SA (high altitude met., design number An-4). Brief data on the standard An-2P are as follows:—

Dimensions: Span, 54ft 2in; length, 34ft 3in.

Weights: Max. take-off, 11,000 lb, payload, 3,300 lb.

Performance: Cruising speed, 97 kt (112 m.p.h.); minimum speed, 35 kt (40 m.p.h.), landing run, 490ft.

An-10A This is the production version of the An-10, which first flew early in 1957. The An-10A entered service with Aeroflot on July 22, 1959, some months behind schedule. It had previously been "reliability tested," on scheduled cargo flights. The pronounced anhedral of the outer wings is a recent modification. The freight door (starboard rear side) is small, and there is no apparent provision (or indeed clearance) for ramp loading. The An-10A has soft tyres and a four-wheel bogie to permit it to operate off grass strips. It has slotted flaps, electric de-icing, a hydraulic power system (more than 2,000 lb/sq in), and the cabin is pressurized to a differential of just over 7 lb/sq in.

Powerplant: Four Ivchenko AI-20 turboprops (the prototype had Kuznetsov NK-4s) of about 4,000 e.s.h.p. each, driving four-blade propellers of about 14ft 9in diameter.

Dimensions: Span, 124ft 8in; length, 121ft 4in; height, 32ft 1in; wing area, 1,293 sq ft.

Weights: Max. take-off, 121,500 lb; capacity payload 32,000 lb; fuel weight, 22,600 lb.

Payload accommodation: Cabin, 7,840 cu ft; cabin max. height, 108in; cabin width, 13ft 6in; baggage and freight, 1,483 cu ft; max. seats, 126.

Fuel capacity: 2,800 Imp. gal approx.

Performance: Cont. cruising speed, 345 kt (395 m.p.h.) at 26,000ft; take-off run, 2,130ft to 2,300ft; landing run, 1,640ft; range (take-off to landing) with 32,000 lb payload, one hour fuel reserves, 1,080 n.m. (1,240 st.m.); range with 23,000 lb payload, one hour fuel reserves, 1,670 n.m. (1,925 st.m.); range with 18,600 lb payload, one hour fuel reserves, 1,850 n.m. (2,130 st.m.).

An-14 Pchelka ("Bee") This light utility transport, powered by two 260 h.p. piston engines is comparable, with the Short S.C.7, or with the Hurel-Dubois-Miles HDM.106 Caravan. It first flew on March 15, 1958. The field performance claimed for the An-14 puts it in the STOL class, and it has a minimum speed claimed to be no more than 27 kt (31 m.p.h.). It appears to have seating accommodation for six people, including one pilot. Large rear-loading doors are fitted.

Powerplant: Two Ivchenko AI-14R piston engines of 260 b.h.p. driving two-bladed 9ft 4in propellers.

Dimensions: Span, 65ft; length, 36ft; height, 13ft 10in; wing area, 474 sq ft; aspect ratio, 9.

Weights: Take-off weight, 6,615 lb; max. permitted take-off weight, 7,055 lb; payload, 1,320 lb.

Payload accommodation: Number of seats, 6.

Performance: Max. speed, 124 kt (143 m.p.h.); cruising speed, 113 kt (130 m.p.h.); take-off run, 130ft; landing run, 195ft; landing speed, 36 kt (41 m.p.h.); minimum speed, 27 kt (31 m.p.h.); rate of climb, 835ft/min, or 235ft/min on one engine; max. range 540 n.m. (620 st.m.).

An-16 This development of the An-10A was announced at the Brussels International Exhibition in April 1958, but it is not known whether an example has yet flown. The fuselage is stretched by 3 m (9ft 10in), permitting 130 seats to be installed, and the design is further modified to give an underfloor cargo hold height of almost 4ft.

AVIA *Ceskoslovenské Závody Automobilové A Letecké, Palackého Nam 4, Prague 2.*

Manufacturers of the Avia 14 (Il-14M): see Ilyushin.

AVIATION TRADERS *Aviation Traders (Engineering) Ltd., 21, Wigmore Street, London, W.1.*

ATL-98 This is a car-ferry modification of the DC-4, 10 of which are to be produced for the British independent Air Charter, which is associated with Aviation Traders. This operator has wanted an aircraft with four engines, capacity for five cars and 25 passengers, long range, cheaper operating costs than the Bristol Freighter, and cheap to buy new. The answer was the ATL-98, a conversion of the DC-4 involving a new nose and a new fin, which—depending upon the granting of long haul vehicle ferry services—would be ready for service in 1961.

Description in *Flight:* June 19, 1959.

Powerplant: Four P. & W. Twin Wasp R2000-7M2 of 1,450 b.h.p. each, driving Hamilton Standard Hydromatic 13ft propellers.

Dimensions: (see also DC-4, page 606). Length, 102ft 7in; height empty, 30ft.

Weights: Max. take-off, 73,800 lb; landing, 64,170 lb; capacity payload, 17,176 lb (car ferry), 17,635 lb (long-range freighter); weight less fuel and payload, 41,824 lb (car ferry), 41,365 lb (long-range freighter).

Payload accommodation: Cabin volume, 4,500 cu ft; baggage volume, 151 cu ft; max. width, 9ft 8in; max. height, 6ft 9in; max. usable floor area, 665 sq ft; dimensions of largest door, 6ft 9in × 6ft 9in; max. seats (subject to A.R.B. requirements), 84; cars, 4 or 5 plus rear seats for 25.

Fuel capacity: 2,998 Imp. gal.

Performance: Cont. cruising speed 180 kt (207 m.p.h.) at 10,000ft and 65,000 lb; corres. consumption 173 gal/hr; balanced field length, max.

Antonov An-10A of Aeroflot (Ivchenko AI-20 turboprops)

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

take-off weight, S.L., I.S.A., 5,300ft; S.L., I.S.A. +15 deg C, 5,950ft; at 5,000ft, I.S.A., 7,100ft; landing distance from 50ft (max. weight) 2,800ft; range A (with max. payload) 1,850 n.m. (2,130 st.m.); range B (with max. fuel), 2,870 n.m. (3,310 st.m.); corres. payload, 10,200 lb; corres. cruise speed, 176 kt (202 m.p.h.).

AVRO *A. V. Roe and Co. Ltd., Greengate, Middleton, Manchester (member of the Hawker Siddeley Group).*

Avro 652A Anson Introduced in 1935, a total of 11,020 Ansons were built, mainly for military communications work. There are 41 still in commercial service, seating 6-9 passengers. Powerplant is two Armstrong-Siddeley Cheetah XV radial engines of 420 h.p.

Avro 685 York C.1 Introduced in 1942, the York was the transport development of the famous wartime Lancaster, the fuselage being the main structural modification. Of 256 built for the R.A.F., 33 continue in civil use—almost exclusively as freighters—with British independents and Middle East operators. Description in *Flight:* August 17, 1944.

Powerplant: Four Rolls-Royce Merlin 502 of 1,610 b.h.p. each, driving D.H. 13ft three-bladed propellers.

Dimensions: Span, 102ft; length, 78ft 6in; height empty (tail down), 20ft; wing area, 1,297 sq ft; aspect ratio, 8.02.

Weights: Max. take-off, 70,000 lb; landing, 65,000 lb; zero fuel, 50,000 lb; capacity payload, 20,000 lb; weight less fuel and payload, 42,000 lb.

Payload accommodation: Cabin volume, 2,450 cu ft; cabin length, 54ft; max. width, 8ft; max. height, 8ft; max. usable floor area, 350 sq ft; dimensions of larger door(s) 7ft 8½in × 6ft 3½in (forward edge), 7ft 8½in × 5ft 4½in (rear edge); max. seats, 24.

Fuel capacity: 2,478 Imp. gal.

Performance: Cont. cruising speed, 183 kt (210 m.p.h.) at 10,000ft and 61,000 lb; corresponding s.f.c. under this condition, .45 lb/b.h.p./hr; balanced field length, max. take-off weight, S.L., I.S.A., 5,750ft; at S.L., I.S.A. +15 deg C, 6,600ft; at 5,000ft I.S.A., 7,900ft; landing distance from 50ft, 4,600ft; range A (max. payload), 1,215 n.m. (1,400 st.m); range B (max. fuel), 2,350 n.m. (2,700 st.m); corres. payload, 11,600 lb; corres. cruise speed 183 kt (210 m.p.h.) at 10,000ft.

Avro 688 Super Trader Developed from the Avro Tudor 4B, the Super Trader has proved itself a most successful passenger-cargo transport. Five are in service, operated by Air Charter.

Description in *Flight:* February 26, 1954.

Powerplant: Four Rolls-Royce Merlin 723 of 1,760 h.p. each driving de Havilland 13ft propellers.

Dimensions: Span, 120ft; length, 84ft 2in; height, 23ft 10in; wing area, 1,422 sq ft.

Weights: Max. take-off, 83,600lb; landing, 74,000 lb; payload, about 18,000 lb.

Payload accommodation: Usable volume, 2,000 cu ft; cabin, 50ft × 8½ft wide × 6ft 9in high; floor, 383 sq ft; loading door, 81in × 66in; max. seats, 50.

Fuel capacity: 3,518 Imp. gal.

Performance: Cont. cruise speed, 190 kt (218 m.p.h.) at 10,000ft at 81-82,000 lb; corres. fuel consumption, 248 gal/hr; take-off distance to 50ft, max. weight, S.L., I.S.A., 5,600ft (8,100ft at 5,000ft I.S.A.); landing distance from 50ft, S.L., I.S.A., 4,500ft; range A (max. payload), 1,600 n.m. (1,840 st.m.); range B (max. fuel), 2,370 n.m. (2,720 st.m.), with 12,000 lb payload, 190 kt (218 m.p.h.).

Avro 748 Announced on January 9, 1959, the 748 is the latest British entry into the DC-3 replacement market. Like its main competitors, the Handley Page Dart Herald and the Fokker Friendship, it is powered by two Rolls-Royce Dart turboprops, though it differs from these aircraft primarily in its low-wing arrangement. The first 748 is due to fly in February 1960, and is to be ready for delivery in the second half of 1961. Twelve are being built.

It is a simple, conventional aircraft, and it is expected to sell for a basic price of £168,000. The 748 is a private venture, and provisional orders have come from the British independents Skyways (3, early 1961) and B.K.S. (2, early 1961). The M. of A. has purchased three at a cost of "about £750,000," for operation by "a United Kingdom airline." The Indian government has decided to build the 748 for the Indian Air Force, which has a large number of Dakotas to replace. The first batch of 748s would be built in the U.K., and the remainder in India. It is probable also that the 748 will be adopted by Indian Airlines.

Operator's reference drawing: page 602. *Flight* references: May 8, 1959 (description), and September 11, 1959.

Powerplant: Two Rolls-Royce Dart RDa.6 Mk 514 turboprops of 1,600 s.h.p. each driving Rotol 12ft four-blade propellers.

Dimensions: Span, 95ft; length, 67ft; height empty, 24ft 10in; wing area, 795 sq ft; aspect ratio, 11.35.

Weights: Max. take-off, 33,000 lb; landing, 33,000 lb; zero fuel, 29,110 lb; capacity payload, 9,666 lb; weight less fuel and payload, 19,444 lb.

Payload accommodation: Cabin volume, 1,990 cu ft; baggage and freight volume, 335 cu ft; cabin length, 46½ft; max. width, 8ft 1in; max. height, 6ft 4½in; max. usable floor area, 296 sq ft; dimensions of doors, 5ft 2in × 2ft 6in, 4ft 6in × 4ft; max. seats, 40-44.

Fuel capacity: 1,100 Imp. gal; water-methanol, 56 Imp. gal.

Performance: Cont. cruising speed, 230 kt (265 m.p.h.) at 20,000ft and 31,000 lb; corresponding s.f.c., 0.686 lb/s.h.p./hr; balanced field length, max. take-off weight, S.L., I.S.A., 3,500ft; at S.L., I.S.A. +15 deg C, 3,750ft; at 5,000ft, I.S.A., 4,750ft; landing distance from 50ft, S.L., at max. take-off weight, 2,190ft; range A (max. payload), 585 n.m. (675 st.m.); range B (max. fuel), 1,565 n.m. (1,805 st.m.); corres. payload, 4,436 lb; corres. cruise speed, 230 kt (265 m.p.h.).

Avro 758 A high-wing, rear-loading version of the 748, for freighting and supply-dropping, the 758 (briefly reported in *Flight* for September 18, p. 240) is a project only. The Indian Air Force is interested.

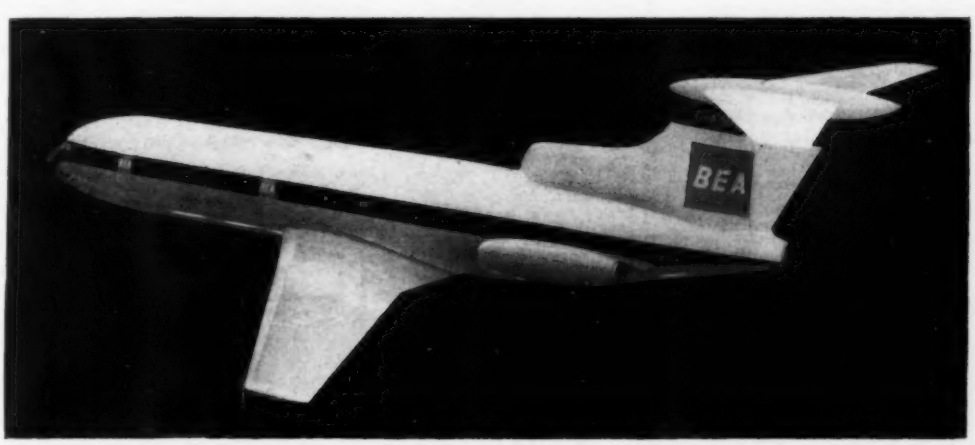
ARMSTRONG WHITWORTH *Sir W. G. Armstrong Whitworth Aircraft Ltd., Baginton, Coventry, Warwickshire.*

AW.650 Argosy The Hawker Siddeley Group's first venture into the civil market, the Argosy is aimed primarily at the big potential air freight business. It is the only pressurized turboprop freighter (four Darts) designed from the outset for civil use, and it is also the only freighter with a swing nose and a swinging aft end to permit the most rapid possible loading facilities.

The first provisional contract for Argosies was announced on February 23, 1959, by the American all-cargo line, Riddle, who later withdrew owing to severe financial difficulties. The first flight was on January 8, 1959, at Bitteswell, and six aircraft were flown in nine months. Ten are being built. Certification is scheduled for March 1960 with deliveries in the summer. A world sales-tour programme is under way. Basic price, completely equipped, £465,000.

An order for 20 AW.660s (the military version of the Argosy) for

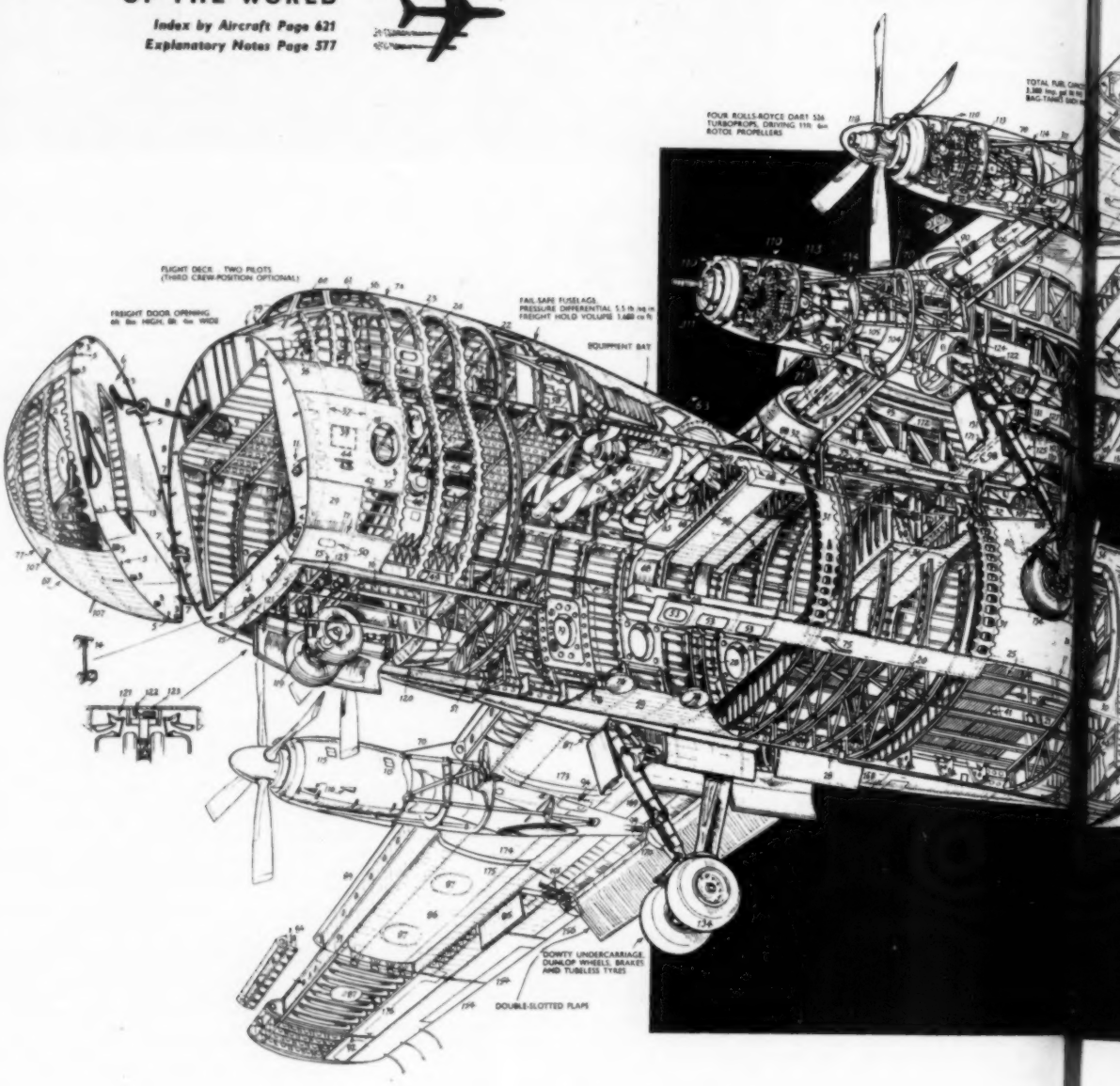
(*Continued on page 582, after double-page drawing of AW.650*)



Airco D.H.121 of B.E.A. (Rolls-Royce RB.163 by-pass turbojets)

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577


FOUR ROLLS-ROYCE DART 526 TURBOPROPS, DRIVING 11ft 6in ROTOL PROPELLERS
FLIGHT DECK: TWO PILOTS (THIRD CREW-POSITION OPTIONAL)
FREIGHT DOOR OPENING 6ft 8in HIGH, 8ft 6in WIDE
FAIL-SAFE FUSELAGE
EQUIPMENT BAY
DOWTY UNDERCARRIAGE, DUNLOP WHEELS, BRAKES AND TUBELESS TYRES
DOUBLE-SLOTTED FLAPS

Fuselage (structure)

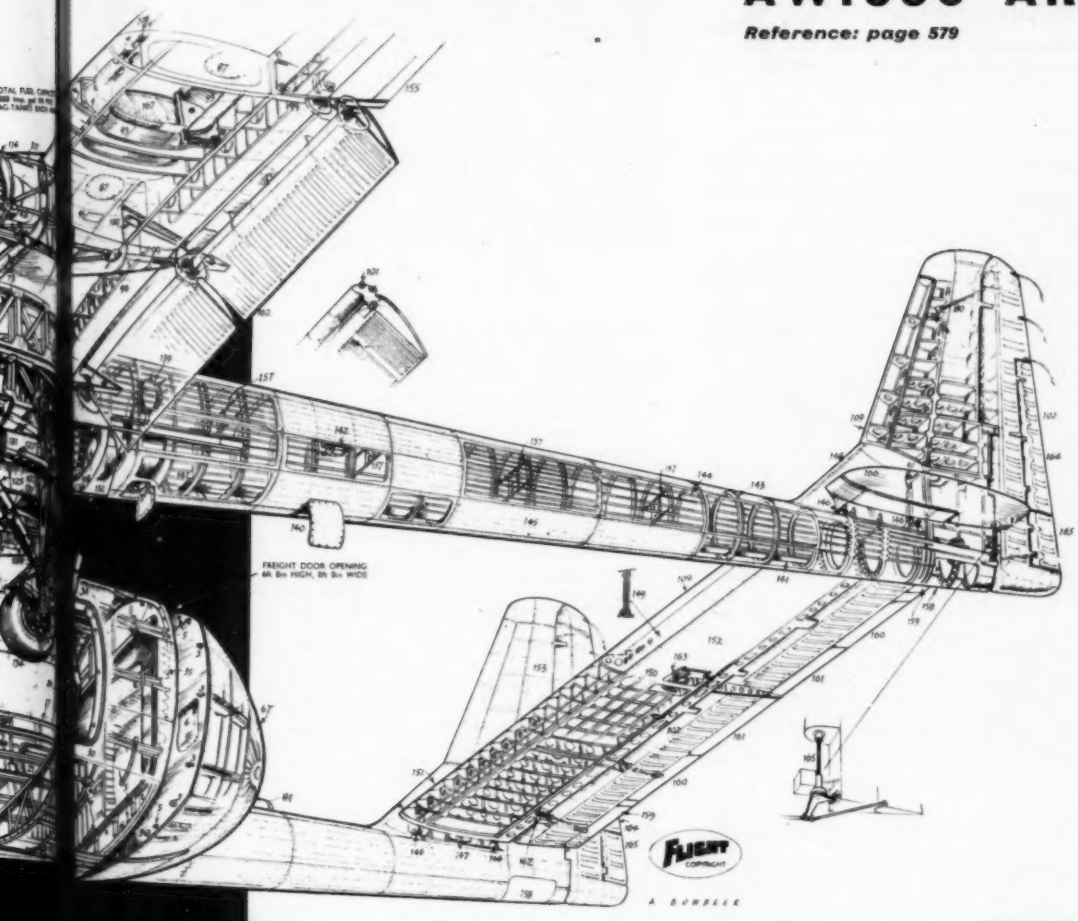
1 Housing for Ekco E.160 radar scanner
2 Scanner hinge boxes
3 Door latching points
4 Fuselage jack assemblies for 3
5 Pressure pads
6 Honeycomb-sandwich bulkheads
7 Three hinges, centre hinge bearing door weight
8 Door-operating screw-jack
9 Two-speed gearbox and driving handle
10 Door-lifting "pole vault" lever, bungee-loaded
11 Receiving block for 10
12 Crew-toilet and washroom floor
13 Baggage-compartment floor
14 Section of Frame 1 showing torsion box and door-sealing angle
15 Stainless-steel external longeron
16 Steel beams for nose undercarriage
17 Hard chine at floor level
18 Windows 18in × 13in
19 Emergency exit 36in × 20in
20 Emergency exit 26in × 19in
21 Emergency door
22 Crew-ditching exit
23 "Finger-plate" rip stoppers
24 Intercostal stringers with carry-through channel boom
25 Six longitudinal rails for freight-lashing or seating
26 Reduxed ends to flight-deck floor beams
27 Wall freight-lashing points
28 Skin 17 s.w.g.
29 Skin 19 s.w.g.
30 Skin 21 s.w.g.
31 Double frames to wing spar attachments
32 Swinging lift link
33 Swinging drag link
34 Passenger door
35 Reduxed doublers around cut-outs
36 Pressure bulkheads at spar cut-outs
37 Frames at 21in pitch
38 Fuselage drain gallery
39 Freight-door locking controls
40 Faired pads for Dowty support struts (rear-loading case)
41 Bonded-sandwich floor panels
42 Folding ladder to flight deck
43 Cupboard for 46, 47 and 48

Fuselage (installed equipment)

44 Pitot head (port and starboard)
45 Oxygen bottle
46 Three 25 amp/hr Varley batteries
47 Control box
48 Ground air-conditioning connection
49 Oxygen charging points
50 Ground D.C. supply socket
51 Centralized dessicant pack
52 Piping to inter-pane airspace
53 Hydraulic service panels
54 Wing inspection light (amber)
55 Control columns
56 Captain's seat
57 Fuel-contents oscillator group
58 Converters, inverters, control panels
59 Nasa glass, electrically heated panels
60 Direct-vision panel
61 Hot-air demisting
62 Radio racks
63 Airflow through primary heat exchanger
64 Cold air unit
65 Secondary silencer
66 Recirculating fan
67 Air-discharge valves
68 Conditioned-air delivery duct
69 Recirculating air intake from lower deck
70 Godfrey Type 15 blowers (engines 1, 2 and 4)
71 Air from 70
72 Blower intakes and filters
73 Primary silencer

AW.650 ARGOSY

Reference: page 579



Aerials

74 V.H.F. No. 1
75 V.H.F. No. 2
76 Twin A.D.F. loops
77 I.L.S. glide-path
78 I.L.S. marker
79 A.D.F. sense
80 V.O.R.
81 H.F.

Wing structure and Flaps

82 Front-spar section
83 Rear-spar section
84 Hinged leading edge
85 Hinged access panels
86 Wing skin 16 s.w.g.
87 Tank access panels
88 Fuselage-frame anchorage on spar neutral axis
89 Aerofoil N.A.C.A. 23018 (modified) root, 23012 tip
90 Centre/intermediate wing joint
91 Intermediate/outer wing joint
92 Detachable tip
93 Tank-bay inner skin
94 Access to No. 3 tank fuel pumps
95 Fuel-water drain panels
96 Secondary structure, made by A.W.A.
97 Hydraulic flap motor, gearbox and transmission
98 Torque tubes
99 Flap attachment ribs
100 Endless chain
101 Roller and guide rail
102 Fluted skin
103 Centre-section flap removed

De-icing

104 Jet-pipe flap valve
105 Ram-air to heat exchanger
106 Warm air through leading edge
107 Ice detectors
108 Warm-air exhaust
109 Spraymat electric de-icing on empennage

Powerplants

110 Airflow through oil cooler
111 Engine air intake
112 Accessory gearbox above jet-pipe
113 Inter-zone firewall
114 Firewall (marking rear limit of Viscount-type power package)
115 Fire access panels
116 Cooling air to Zones 1 and 2
117 Cooling air to generator
118 Electrically heated spinner and intake

Undercarriage

119 Nose-undercarriage towbar attachment
120 Fixed fairing
121 Four interlinked doors
122 Retraction jack
123 Steering motor
124 Tubular support pyramid
125 Radius rod
126 Light-alloy main leg, breaking in centre
127 Breaker strut
128 Spring unit
129 Triple brake pipe
130 Maxaret unit
131 Fairing door and forward leg doors all linked to radius rod
132 Rear doors with sequenced hydraulic operation
133 Main-undercarriage lugs for rearwards towing bridle
134 Nylon ply tyres, 1.50×20

Booms

135 Top mounting on upper boom of rear spar
136 Bottom mounting with tubular bracing
137 Sub-longerons
138 Removable doors
139 Hydraulic header tank
140 Stress-bearing access hatch to 139
141 Catwalk, whole length of boom
142 Junction boxes
143 Light channel-section frames
144 Stringers lightly riveted over frames
145 Thick skin (14 s.w.g.)

Empennage

146 Tailplane attachment frames
147 Locating spigot
148 Non-structural fairing
149 Spar with two bonded webs
150 Bonded stringers
151 Detachable leading edges
152 Tailplane section N.A.C.A. 0012
153 Fin section N.A.C.A. 0014

Flying Controls

154 Aileron spring tabs
155 Aileron trim/geared tab
156 Aileron geared tab
157 Fairlead for elevator and rudder cables
158 Access to rudder-cable tension regulators
159 Elevator trim tab
160 Elevator torsion-bar spring tab
161 Elevator geared tab
162 Trim-tab screw-jack
163 Elevator-cable tension regulator
164 Rudder trim/geared tab
165 Rudder torsion-bar spring tab
166 Elevator horn balance

Fuel System

167 Flexible fuel tanks between spars
168 Water/methanol tank, 68 Imp. gal in each boom
169 Pressure fuelling/defuelling socket on each main-undercarriage radius rod
170 Pressure fuelling sockets for water/methanol system
171 Refuelling switch panels on aft face of fairing door
172 No. 1 tank, 362 Imp. gal
173 No. 2 tank, 463 Imp. gal
174 No. 3 tank, 405 Imp. gal
175 No. 4 tank, 320 Imp. gal
176 No. 5 tank, 100 Imp. gal

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

R.A.F. Transport Command will be of considerable value to the civil production programme.

Cutaway drawing, pages 580-81. *Flight* description, October 17, 1958.

Powerplant: Four Rolls-Royce Dart 526 (RDa.7/2) of 2,100 e.s.h.p. each, driving Rotol Type R.186/4-30 11ft 6in propellers.

Dimensions: Span, 115ft; length, 86ft 9in; height empty, 27ft 9in; wing area, 1,458 sq ft; aspect ratio, 9.07.

Weights: Max. take-off, 82,000 lb; landing, 78,000 lb; zero fuel, 74,000 lb; capacity payload, 27,000 lb; weight less fuel and payload, 46,420 lb.

Payload accommodation: Cabin volume, 3,680 cu ft; passengers' baggage volume, 182 cu ft; cabin length, 46ft 10in; max. width, 11ft 8in; max. height, 8ft 9in; max. usable floor area, 426 sq ft; dimensions of largest doors, 6ft 8in × 8ft 8in; max. seats, 83.

Fuel capacity: 3,300 Imp. gal; water-methanol, 137 Imp. gal.

Performance: Cont. cruising speed 263 kt (302 m.p.h.) at 20,000ft and 70,000 lb; corres. consumption 0.089 n.m./lb; balanced field length, max. take-off weight, S.L., I.S.A., 4,050ft; at S.L., I.S.A.+15 deg C, 4,350ft; at 5,000ft I.S.A., 5,500ft; landing distance from 50ft, 2,700ft; range A (max. payload), 600 n.m. (690 st.m.); range B (max. fuel), 2,390 n.m. (2,750 st.m.); corres. payload, 8,600 lb; corres. cruise speed, 258 kt (296 m.p.h.).

AW.670 Air Ferry This project is a variant of the Argosy, intended for car-ferry operations or for short haul, very high density (126 seats) passenger operations. As the latter it is designated **AW.671 Airbus.** It has a bigger, non-pressurized fuselage. Data which differ from the Argosy are as follows:—

Payload accommodation: Cabin volume, 1,058 cu ft upper deck, 4,260 cu ft lower deck; baggage volume, 250 cu ft; cabin length, 42ft; max. width, 15ft; max. height, 7ft; max. usable floor area, 610 sq ft; dimensions of largest door 7ft × 15ft; max. seats, 126.

Performance: Cont. cruising speed, 237 kt (272 m.p.h.) at 10,000ft and 75,000 lb; corres. fuel consumption, 0.065 n.m./lb; balanced field length, max. take-off weight, S.L., I.S.A., 4,050; at S.L., I.S.A., +15 deg C, 4,350ft; at 5,000ft, I.S.A., 5,500ft; landing distance from 50ft, 2,700ft; range A (max. payload), 460 n.m. (530 st.m.); range B (max. fuel) 1,620 n.m. (1,860 st.m.); corres. payload, 8,800 lb; corres. cruise speed, 233 kt (268 m.p.h.).

BAADE Leader of the design team responsible for East Germany's Aeronautical Institute at Dresden is Prof. Bruno Baade.

BB-152 Roughly comparable in capacity and purpose with the Caravelle, the 57-72-passenger BB-152 is the first aircraft to be designed and built in either of the two Germanys since 1945. First flight reportedly took place on December 4, 1958, at Dresden, roll-out having been in May 1958. An early 152 was lost with its crew on March 4, 1959.

Further *Flight* references: July 25, 1958; April 10, 1959.

The following data (May 1959), are metric conversions, and are believed to be reliable:—

Powerplant: Four Pirna 014 of 6,950 lb (3,150 kg) thrust each.

Dimensions: Span, 88ft 7in; length, 103ft; height (approx.), 30ft; wing area, 1,464 sq ft.

Weights: Max. take-off, 105,820 lb; landing, 89,500 lb; zero fuel, 76,200 lb (57 pass.), or 80,200 lb (72 pass.); capacity payload, 17,650 lb (57 pass. and freight), or 20,400 lb (72 pass. and freight); weight less fuel and payload, 33,300 lb (57 pass. version); 33,500 lb (72 pass. version).

Payload accommodation: No. of seats, 57 "normal," 72 tourist five-abreast.

Fuel capacity: Fuel weight with 57 seats given as 9,920 kg.

Performance: Cont. cruising speed, 442 kt (508 m.p.h.); cruising height, 34-38,000ft; "I.C.A.O. take-off distance" over 35ft, 4,310ft; landing run at 77,000 lb, 2,260ft; range with max. payload (20,400 lb), 1,080 n.m. (1,240 st.m.); range with 16,000 lb payload, 1,350 n.m.

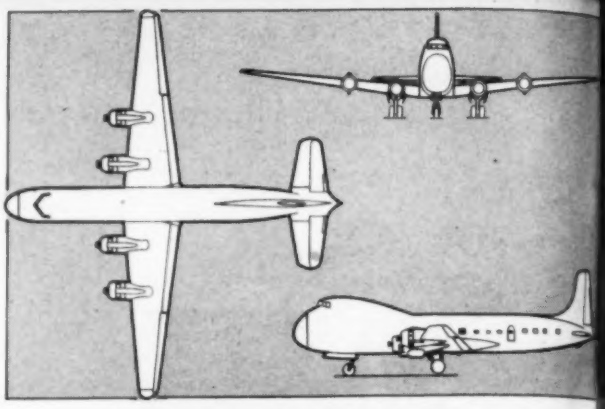
BOEING *Boeing Airplane Company, Transport Division, Renton, Washington, U.S.A.*

Boeing 307 Stratoliner First flown on December 31, 1938, the Stratoliner was a civil development of the B-17 bomber. Of the same generation as the DC-4, and a direct competitor, it went into service with Pan American and T.W.A. in the early months of 1940. It was an airliner in advance of its time, being the first pressurized airliner to go into service, and although only ten were built, eight remain in service to this day: Cohata (1), Air Laos (1), Aigle Azur (5), and Air Vietnam (1).

Powerplant, four Wright R-1820-G102As of 1,100 b.h.p. each; max. weight, 42,000 lb; span, 107ft 3in; wing area, 1,486 sq ft; cruising speed, 174 kt (200 m.p.h.); no. of seats, 33.

Flight reference: May 23, 1958, pages 712-714.

Boeing 377 Stratocruiser The Stratocruiser was developed from the YC-97, a transport derivative of the B-29 bomber. The first YC-97 flew in November 1944. The Stratocruiser was ordered by Pan American, Northwest, United, American, B.O.A.C. and S.A.S. (whose order was subsequently transferred to B.O.A.C.). The aircraft entered service in 1949, and its renowned comfort maintained its position in the front rank until as recently as 1958, when it was still in service with both Pan American and B.O.A.C. on the North Atlantic run. Altogether a total of 56 were built, 49 of which are still owned by Northwest (9), PanAm (24), Transocean (14), and B.O.A.C. (2). No fewer than 888 C-97 transports and KC-97 tankers were built for the U.S. Air Force.



Aviation Traders ATL-98 (P. & W. Twin Wasps)

Powerplant: Four Pratt & Whitney Wasp Major R-4360B-6 of 3,500 b.h.p. each driving 16½ft Hamilton Standard propellers.

Dimensions: Span, 141ft; length, 110ft 4in; height, 38ft 3in.

Weights: Max. take-off, 145,800 lb; landing, 121,700 lb; zero fuel, 115,930 lb; capacity payload, 23,640 lb; weight less fuel and payload, 92,000 lb.

Payload accommodation: Cabin volume, 5,500 cu ft approx; baggage and freight hold volume, 800 cu ft; cabin length, 79ft 3in; max. width, 10ft 4in; max. height, 7ft; dimensions of doors, 70in × 29in; max. seats, 81, including 14 in lower deck lounge.

Fuel capacity: 6,480 Imp. gal (7,790 U.S. gal).

Performance: Cont. cruise speed, 262 kt (302 m.p.h.); corres. fuel consumption, 457 Imp gal/hr; balanced field length, max. take-off weight, sea level, I.S.A., 7,100ft; range B (max. fuel), 3,830 n.m. (4,400 st.m.).

Boeing 707 The 707 family of Boeing jet airliners, which were developed as a private venture out of the company's unique jet bomber (B-47, B-52) experience, comprises six types of transport, listed below.

The prototype 707, the 367-80, which first flew in July 1954, led to a big U.S.A.F. order for KC-135 jet tankers. More than 320 of these have been delivered against an order for a total of 426, contributing significantly to the commercial production programme.

The first 707 order came on October 13, 1955 from Pan American; the first 707-120 flew on December 20, 1957; and deliveries (to PanAm) began in September 1958 ahead of schedule. The 707 was introduced into regular service across the North Atlantic (by PanAm) on October 26, 1958. To date about 70 707s have been delivered to six operators and the order book stands at 190 for 17 operators, as follows:

707-120 Pan American, 6; American, 16 (current) plus 10 707-120B; Continental, 4; T.W.A., 15 (current); Qantas, 7; Cubana, 2 (March-June, 1960); U.S.A.F. (VC-137A), 3.

707-220 Braniff, 5 (current).

707-320 Pan American, 23 (current); Air France, 17 (current); Sabena, 5 (December 1959); T.W.A., 12 (current); S.A.A., 3 (July, 1960).

707-420 B.O.A.C., 15 (December 1959); Lufthansa, 4 (summer 1960); Air India, 3 (January 1960); Varig, 2 (July 1960).

720 American, 25 (all 720Bs, early 1960); United, 11 (April 1960); Aerlinte, 3 (November 1960).

Description in *Flight:* July 25, 1958, p. 144-147.

707-120 This is the JT3 domestic model. Basic price: £1.68m.

Powerplant: Four Pratt & Whitney JT3C-6 turbojets of 11,200 lb dry thrust each or 13,000 lb with water injection.

Dimensions: Span, 130ft 10in; length, 144ft 6in; height empty, 38ft 5in; wing area, 2,433 sq ft; aspect ratio 7.07.

Weights: Max. take-off, 247,000 lb; landing, 175,000 lb; zero fuel, 165,000 lb; capacity payload, 43,000 lb.

Payload accommodation: Cabin volume, 8,294 cu ft; baggage and freight, 1,703 cu ft; cabin length, 104ft 10in; max. width, 12ft 4in; max. height, 14ft 2½in; max. usable floor area, 1,092 sq ft; dimensions of largest door, 34in × 72in; max. seats, 179.

Fuel capacity: Basic, 13,478 U.S. gal plus 710 U.S. gal of water.

Performance: Cont. cruising speed, 495 kt (570 m.p.h.) at 28,000ft and 180,000 lb; balanced field length at max. take-off weight, S.L., I.S.A., 10,200ft; C.A.R. landing distance from 50ft at max. landing weight, 6,000ft; range A (max. payload) I.S.A. (SR427 reserves), 2,720 n.m. (3,130 st.m.); range B (maximum fuel) (SR427 reserves), 3,750 n.m. (4,310 st.m.); corres. payload, 20,500 lb.

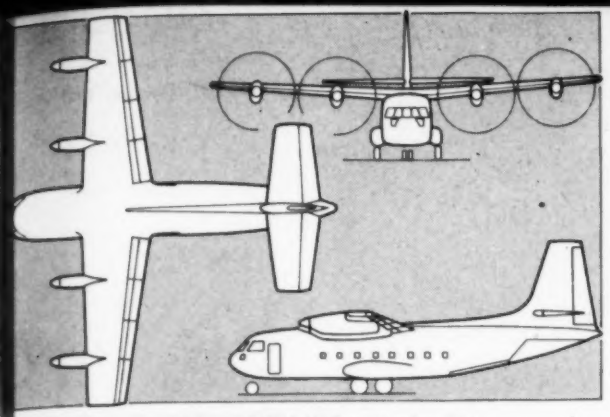
707-120B The 707-120B is distinguished by turbofan engines and the wing modifications applied to the 720, namely, three sections of leading edge flap and a false leading edge between inner pod and fuselage. The result will be improved field performance, increased economy, and an increase in high-speed cruise of 18 kt. These changes can be incorporated retrospectively, and American Airlines will convert their fleet of -120s in 1960-61 when the turbofans are ready for service.

Powerplant: Four Pratt & Whitney JT3D-1 turbofans of 17,000 lb dry thrust.

Dimensions: Approx. as 707-120.

Weights: Max. take-off, 258,000 lb; zero fuel, 170,000 lb; max. payload, 53,000 lb.

Payload accommodation and fuel capacity: As 707-120 (no water injection).



Breguet 941 (D.H. Gnome turboprops)

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

Performance: Cont. high speed cruise, 526 kt (604 m.p.h.) at 25,000ft and 210,000 lb; corres. consumption, 21,950 lb/hr; balanced field length, sea level, I.S.A., 8,600ft; I.S.A.+15 deg C, sea level, 10,000ft; landing distance, as -120; range A (max. payload), 3,570 n.m. (4,110 st.m.); range B (max. fuel), 5,200 n.m. (5,990 st.m.); corres. payload, 24,700 lb; corres. speed, 461 kt (530 m.p.h.) at 37,500ft.

707-220 This is a shorter-body domestic version, powered by JT4s, ordered by one customer, Braniff. This operator wanted a higher reserve of power to meet the high-altitude, high-temperature conditions experienced on its Latin American routes.

Powerplant: Four P. & W. JT4A-3 turbojets of 15,800 lb dry thrust each (no water injection).

Dimensions: As for the -120, except for length, 134ft 6in.

Weights: As for the -120, except for capacity payload, 34,000 lb.

Payload accommodation: Approximately as for the -120.

Fuel capacity: As for the -120, but without water.

Performance: Cont. cruise speed, approx. as for -320; balanced field length, max. take-off weight, S.L., I.S.A., 6,900ft; landing distance from 50ft at max. landing weight, 6,000ft; range A (max. payload), 3,980 n.m. (4,580 st.m.); range B (max. fuel), (SR427 reserve), 3,875 n.m.

707-320 Known as the Intercontinental, the -320 is the long-range model. Basic price: £1.77m.

Powerplant: Four P. & W. JT4A-3 of 15,800 lb thrust each (no water injection fitted).

Dimensions: Span, 142ft 5in; length, 152ft 11in; height empty, 38ft 8in; wing area, 2,892 sq ft; aspect ratio, 7.06.

Weights: Max. take-off, 315,000 lb; landing, 207,000 lb; zero fuel, 190,000 lb; capacity payload, 53,000 lb.

Payload accommodation: Cabin volume, 8,150 cu ft; baggage and freight volume, 1,700 cu ft; cabin length, 111ft 6in; max. width, 12ft 4in; max. height, 14ft 2½in; max. usable floor area, 1,164 sq ft; dimensions of largest door, 34in × 72in; max. seats, 189.

Fuel capacity: Basic, 21,200 U.S. gal (no water), (17,650 Imp. gal).

Performance: Cont. cruising speed, 520 kt (598 m.p.h.) at 23,000ft and 260,000 lb; balanced field length at max. take-off weight, S.L., I.S.A. (C.A.R. 422B) 11,000ft; landing distance from 50ft at max. landing weight (C.A.R.) 6,450ft; range A (max. payload) and SR427 reserves, 3,875 n.m. (4,450 st.m.); range B (max. fuel) optimum cruise (SR427 reserves), 4,920 n.m. (5,650 st.m.); corres. payload, 22,000 lb.

707-420 This is the Rolls-Royce Conway-powered version, also known as the Intercontinental, as ordered by B.O.A.C., Air-India, Lufthansa and Varig. A cutaway drawing appears on pages 584-585.

Powerplant: Four Rolls-Royce Conway 505 of 17,500 lb thrust each (no water injection fitted).

Dimensions: Span, 142ft 5in; length, 152ft 11in; height empty, 38ft 8in; wing area, 2,892 sq ft; aspect ratio, 7.06.

Weights: Max. take-off, 315,000 lb; landing, 207,000 lb; zero fuel, 190,000 lb; capacity payload, 55,000 lb.

Payload accommodation: Cabin volume, 8,150 cu ft; baggage and freight volume, 1,700 cu ft; cabin length, 111ft 6in; max. width, 12ft 4in; max. height, 14ft 2½in; max. usable floor area, 1,164 sq ft; dimensions of largest door, 34in × 72in; max. seats, 189.

Fuel capacity: Basic, 21,200 U.S. gal (17,650 Imp. gal).

Performance: Cont. cruising speed 520 kt (598 m.p.h.) at 23,000ft and 260,000 lb; balanced field length at max. take-off weight, S.L., I.S.A., (C.A.R. 422B), 10,650ft; landing distance from 50ft at max. landing weight (C.A.R.), 6,600ft; range A (max. payload) SR427 reserves, 3,875 n.m. (4,450 st.m.); range B (max. fuel) optimum cruise (SR427 reserves) 4,920 n.m. (5,650 st.m.); corres. payload, 22,000 lb.

720 (707-020) The fastest addition to the family, the 720 has the leading edge "glove" which extends the wing chord between fuselage and inner pod to increase Mach number from 0.88 to 0.90. In addition, "lift-booster" leading-edge flaps, three per side, will improve landing and take-off characteristics. (See also 707-120B.) Basic price: £1.25m.

Powerplant: Four P. & W. JT3C-7 turbojets of 12,000 lb dry thrust each (no water injection fitted).

Dimensions: Span, 130ft 10in; length, 136ft 2in; height empty, 38ft 4in; wing area, 2,433 sq ft; aspect ratio 7.07.

Weights: Max. take-off, 203,000 lb; landing, 175,000 lb, zero fuel, 139,000 lb; capacity payload, 37,000 lb.

Payload accommodation: Cabin volume, 7,618 cu ft; baggage and freight volume, 1,340 cu ft; cabin length, 94ft; max. width, 12ft 4in; max. height, 14ft 2½in; max. usable floor, 1,003 sq ft; max. seats, 149.

Fuel capacity: Basic, 11,500 U.S. gal (no water), (9,200 Imp. gal).

Performance: Cont. cruising speed, 530 kt (615 m.p.h.) at 22,000ft and 180,000 lb; balanced field length, max. take-off weight, S.L., I.S.A. (C.A.R. SR422B), 7,400ft; landing distance from 50ft; max. landing weight (C.A.R.), 5,750ft; range A (max. payload) and SR427 reserve, 2,475 n.m. (2,850 st.m.); range B (max. fuel) optimum cruise (SR427 reserve), 3,140 n.m. (3,610 st.m.); corres. payload, 18,000 lb.

720B This is the 720 fitted with P. & W. JT3D turbofans of 17,000 lb static thrust each. Deliveries can be made in 1961, and the aircraft shows significant improvements compared with the 720. Maximum weight is 221,000 lb, and zero fuel weight is increased to 144,000 lb. Cruising speed is increased by 15 to 20 kt and range by 800 to 1,000 n.m.

727 Still a project, this is a short-range jet airliner in the D.H.121/DC-9 category. One design is for an aircraft of 110,000 lb with a 1,250 sq ft wing area, powered by two P. & W. JT3D turbofans of 17,000 lb thrust each. Another is for an aeroplane of the same weight, but with a butterfly tail and three rear mounted Rolls-Royce RB.163s of 10,100 lb static thrust.

735 This is a swing-tail, long-range freighter version of the Boeing 707-320. A mock-up of the fuselage has been completed and Boeing say that deliveries could be made in 1961. Powerplants are to be Pratt & Whitney JT3D-3W turbofans of 18,000 lb thrust. Dimensions are similar to those of the 707-320 except that the fuselage is one foot longer. Maximum payload is 98,217 lb and gross weight 316,000 lb; a payload of 64,000 lb can be carried over a range of 3,500 n.m. It is claimed that the freighter's direct operating cost would be three cents per ton mile.

BREGUET *Société Anonyme des Ateliers d'Aviation Louis Bréguet, 24, Rue Georges-Bizet, Paris 16e, France.*

Bréguet 763 Deux Ponts The Deux Ponts stems from the Bréguet Type 761, the design of which was started in 1944 and which flew for the first time on February 15, 1949. The Deux Ponts fuselage is the same as that of the 761 but the span is increased and the wings reinforced; twelve 763s were ordered by Air France in 1951 (it is operated by the French airline under the name Provence) and the prototype flew for the first time on July 20, 1951. The Service version, the Type 763, is known as the Sahara, and 15 of these were ordered in 1956.

Flight references: January 24, 1958, March 28, 1958.

Powerplant: Two Pratt & Whitney R-2800-CA18s driving Hamilton Standard propellers.

Dimensions: Span, 141ft; length, 94ft 11in; height, 31ft 8in; wing area, 2,350 sq ft.

Weights: Max. take-off, 113,757 lb; landing, 105,821 lb; zero fuel, 100,630 lb; capacity payload, 26,960 lb; weight less fuel and payload, 73,570 lb.

Payload accommodation: Cabin volume (lower deck), 2,443 cu ft; total (both decks), 5,897 cu ft; cabin length (upper), 51ft; (lower) 43ft; max. seats, 135.

Fuel capacity: 3,300 Imp. gal (3,963 U.S. gal).

Performance: Cont. cruise speed, 141 kt (220 m.p.h.); corres. fuel consumption, 330 Imp. gal/hr; take-off field length, 5,600ft; range B (max. fuel), 2,370 n.m. (2,740 st.m.).

Bréguet 940 Integral A STOL research machine built to French Government contract, the Integral first flew on May 21, 1958. Its trials have substantiated Bréguet's belief that good cruising speed and carrying capacity are aerodynamically reconcilable with STOL capabilities without helicopter propulsion. The basic concept is the "vectored slipstream": four big interconnected propellers blow across the whole span of a normally loaded wing which is generously endowed with full-span double-slotted flaps. Powerplant consists of four Turboméca Turmo II turboprops of 400 h.p. each. Loaded weight is 16,000 lb.

Flight reference: May 30, 1958.

Bréguet 941 This is the commercial derivation of the 940 research vehicle, powered by four D.H. Gnome turboprops and with accommodation for up to 48 passengers or 21,000 lb of freight, for operation from strips not exceeding 1,300ft. A prototype will be built when Bréguet receive a Government contract. A licence agreement with Piasecki gives the U.S. firm exclusive sales representation in North America, and the 941 will be assembled in the U.S.A.

Powerplant: Four de Havilland Gnome P.1250(T58) turboprops of 1,250 s.h.p. each driving Bréguet reversing propellers.

Dimensions: Span, 77ft; length, 71ft; height, 29ft; wing area, 915 sq ft.

Weights: Max. take-off, 44,000 lb; capacity payload, 19,850 lb to 21,000 lb; weight less fuel and payload, 23,200 lb to 24,300 lb.

Payload accommodation: Cabin volume (cargo version with rear doors and built-in ramp), 1,830 cu ft; max. usable floor area, 260 sq ft; internal dimensions (approx. only), 30ft × 8ft wide × 8ft high; supplementary front loading door, 6ft × 2ft 7in; max. seats, 48.

Performance: Cruising speed "exceeding 220 kt" (250 m.p.h.); take-off and landing "to clear standard obstacle with one engine out," 650ft to 1,300ft runway-length; "range with 40 passengers (8,800 lb), 970 n.m."

BRISTOL *Bristol Aircraft Ltd., Filton House, Bristol, England.*

Bristol Type 170 Freighter The prototype Freighter flew on Decem-

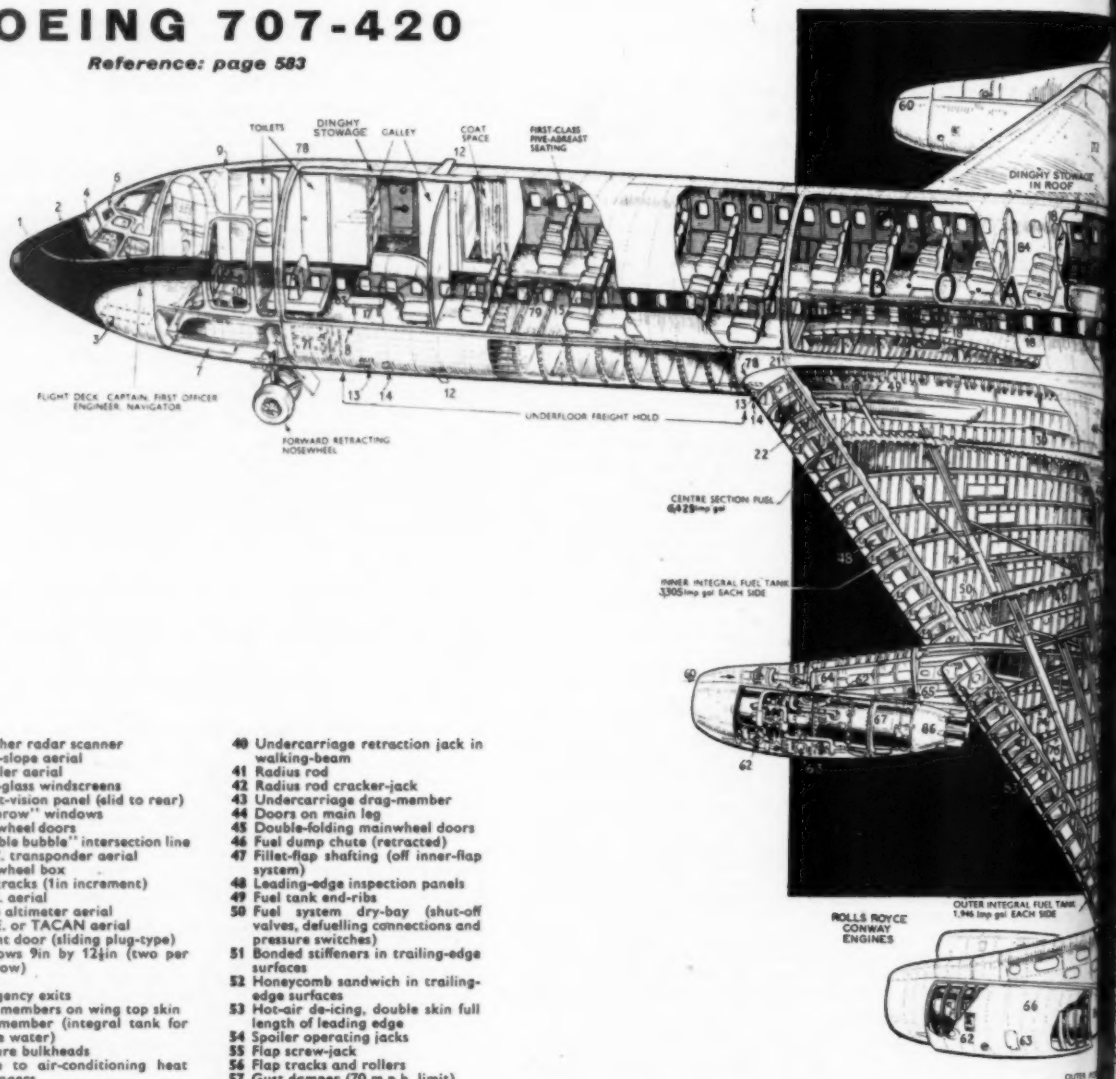
(*Continued on page 586, after double-page drawing*)

COMMERCIAL AIRCRAFT OF THE WORLD

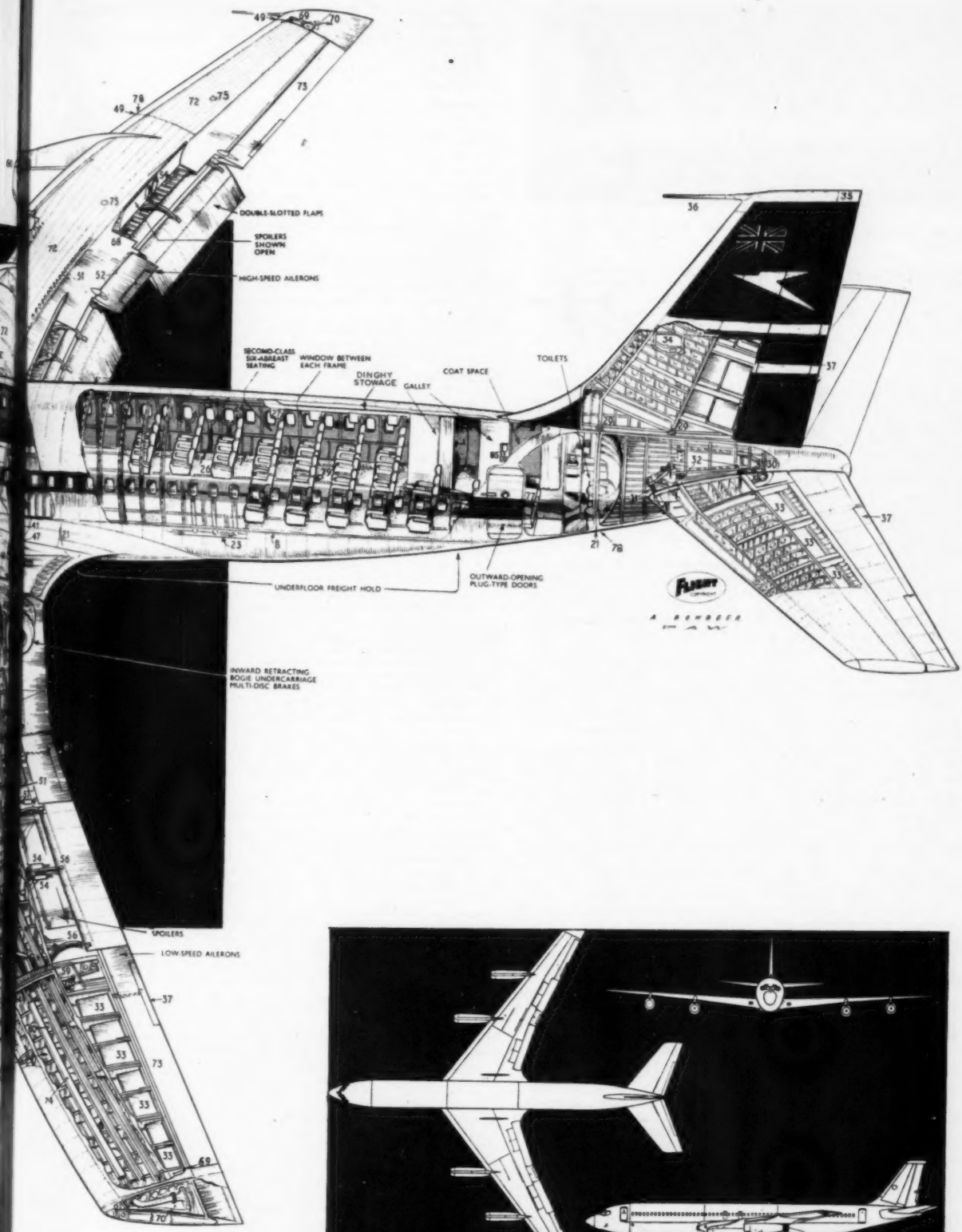
Index by Aircraft Page 621
Explanatory Notes Page 577

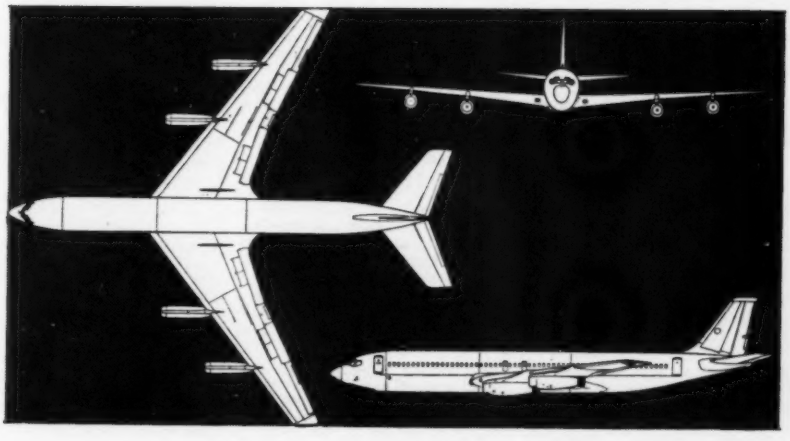
BOEING 707-420

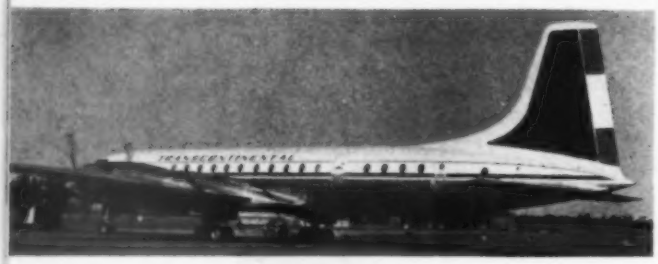
Reference: page 583


TOILETS
DINGHY STOWAGE
GALLEY
COAT SPACE
FIRST-CLASS FIVE-ABREAST SEATING
DINGHY STOWAGE IN ROOF
FLIGHT DECK: CAPTAIN, FIRST OFFICER, ENGINEER, NAVIGATOR
FORWARD RETRACTING NOSEWHEEL
UNDERFLOOR FREIGHT HOLD
CENTRE SECTION FUEL 6,425 Imp gal
INNER INTEGRAL FUEL TANK 3,305 Imp gal EACH SIDE
OUTER INTEGRAL FUEL TANK 1,946 Imp gal EACH SIDE
ROLLS ROYCE CONWAY ENGINES

1 Weather radar scanner
2 Glide-slope aerial
3 Doppler aerial
4 Nesa-glass windscreens
5 Direct-vision panel (slid to rear)
6 "Eyebrow" windows
7 Nosewheel doors
8 "Double bubble" intersection line
9 A.T.C. transponder aerial
10 Nosewheel box
11 Seat tracks (1in increment)
12 V.H.F. aerial
13 Radio altimeter aerial
14 D.M.E. or TACAN aerial
15 Freight door (sliding plug-type)
16 Windows 9in by 12½in (two per seat row)
17 Table
18 Emergency exits
19 Floor members on wing top skin
20 Keel member (integral tank for engine water)
21 Pressure bulkheads
22 Intake to air-conditioning heat exchangers
23 Cabin-air distribution ducts
24 Air passing up between windows
25 Air delivery ducts under hat-racks
26 Air extraction at floor level
27 "Passenger service units"
28 "Hot-wall" panelling
29 Fin/fuselage points
30 Pivot for variable-incidence tail-plane
31 Tailplane screw jack
32 Tailplane centre-section joints
33 Control-surface balance panels
34 V.O.R. aerial
35 Loran aerial
36 H.F. aerial
37 Control tabs
38 Leg trunnion at end of forged rib
39 "Beaver tail" members top and bottom
40 Undercarriage retraction jack in walking-beam
41 Radius rod
42 Radius rod cracker-jack
43 Undercarriage drag-member
44 Doors on main leg
45 Double-folding mainwheel doors
46 Fuel dump chute (retracted)
47 Fillet-flap shafting (off inner-flap system)
48 Leading-edge inspection panels
49 Fuel tank end-ribs
50 Fuel system dry-bay (shut-off valves, defuelling connections and pressure switches)
51 Bonded stiffeners in trailing-edge surfaces
52 Honeycomb sandwich in trailing-edge surfaces
53 Hot-air de-icing, double skin full length of leading edge
54 Spoiler operating jacks
55 Flap screw-jack
56 Flap tracks and rollers
57 Gust damper (70 m.p.h. limit)
58 Aileron/spoiler linkage
59 Low-speed aileron linkage
60 Intake to cabin-air turbo-compressor (engines 2, 3 and 4)
61 Outlet from turbo-compressor
62 De-icing air
63 Oil filler
64 Main engine mounting
65 Rear engine "steady"
66 Cowlings open from bottom centre line
67 Firewalls
68 Cove-lip door (covers gap when flaps up)
69 Fuel system surge-tank
70 N.A.C.A.-type inlet to tank vent system
71 Electrical racks (forced aircooled)
72 Two (independent) boost pumps in each main tank
73 Honeycomb-sandwich aileron skins
74 Surge chambers
75 Gravity fuel fillers
76 Pressure-refuelling dry bay
77 Cabin attendants' seats
78 Production break-lines
79 Wide-angle lens for freight hold inspection
80 Tank access doors
81 Spring tab (full surface movement available for ground test)
82 Tank vent system formed by wing stringers
83 Eight-seat lounge
84 Dividing screen (1st class forward, tourist aft)
85 Drinking fountain
86 Noise suppressors


DOUBLE-SLOTTED FLAPS
SPOILERS SHOWN OPEN
HIGH-SPEED AILERONS
SECOND-CLASS SIX-ABREAST SEATING
WINDOW BETWEEN EACH FRAME
DINGHY STOWAGE
GALLEY
COAT SPACE
TOILETS
UNDERFLOOR FREIGHT HOLD
OUTWARD-OPENING PLUG-TYPE DOORS
INWARD RETRACTING BOGIE UNDERCARRIAGE MULTI-DISC BRAKES
SPOILERS
LOW-SPEED AILERONS
FLIGHT
A BOWDEN PUBLICATION





Bristol Britannia 308 of Transcontinental (Four Bristol Proteus 765)

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

ber 2, 1945. First versions were the **Mk 21** and **Mk 21A**, respectively, the pure freighter and mixed passenger/freight versions with nose-loading doors; the **Mk 22** was an all-passenger (32-36 seats) version without nose doors. The **Mk 31** had increased power and take-off weight, and the **Mk 32**, designed for Silver City, had increased length for car ferry work. A total of 214 Freighters were built for military and civil operators: notable among the latter are Silver City and Air Charter. About 66 remain in commercial use with 19 operators. The following data apply to the **Mks 31 and 32**:—

Powerplant: Two Bristol Hercules 734 piston engines of 2,050 h.p. each driving D.H. 14ft propellers.

Dimensions: Span, 108ft; length, 68ft 4in (Mk 31), 73ft 8in (Mk 32); height empty, 24ft; wing area, 1,487 sq ft.

Weights: Max. take-off, 44,000 lb; landing, 44,000 lb; capacity payload, 14,400 ib (Mk 31), 12,000 lb (Mk 32); weight less fuel and payload, 28,084 lb (Mk 31), 30,553 (Mk 32).

Payload accommodation: Cabin volume, 2,360 cu ft (Mk 31), 2,900 cu ft (Mk 32); cabin length, 49ft (Mk 31), 57ft 2in (Mk 32); max. width, 8ft; max. height, 6ft 7½in; nose door, 6ft 8½in × 6ft 7½in.

Fuel capacity: 1,172 Imp. gal.

Performance: Cont. cruise speed, 166 kt (191 m.p.h.) at 10,000ft at 44,000 lb; corres. fuel consumption, 1.3 st.m.p.g.; balanced field length, max. take-off weight, S.L., I.S.A., 3,700ft; S.L., I.S.A. +15 deg C, 4,100ft; 5,000ft, I.S.A., 4,800ft; landing distance from 50ft, 2,280ft; range A (max. payload), 695 n.m. (800 st.m.); range B (max. fuel), 1,610 n.m. (1,850 st.m.); corres. payload, 5,000 lb; corres. speed, 143 kt.

Britannia 100 First of the Britannia family of big turboprop airliners, powered by Proteus 705 turboprops and seating up to 92 passengers, the 100 was produced exclusively for B.O.A.C. The prototype 100, G-ALBO, first flew on August 16, 1952. Fifteen, designated 102, were built for the Corporation from 1954-56, production being subsequently concentrated on the larger and more powerful 250/300/310/320 series described below. The 102 inaugurated the first Britannia services on February 1, 1957, and a *Flight* special issue of that date described the background to its introduction into service. Further *Flight* references were given on p. 129 of that issue; other articles will be found in the issues of July 6, 1956; November 1, 1957; and July 25, 1958. Price paid by B.O.A.C. (fixed in April 1955) was £768,000 per aircraft.

Powerplant: Four Bristol Proteus 705 turboprops of 3,900 e.h.p. each driving D.H. four-bladed, 16ft propellers.

Dimensions: As for 320, except length, 114ft, and height 36ft 8in.

Weights: Max. take-off, 155,000 lb; landing, 125,000 lb; zero fuel, 113,000 lb; capacity payload, 25,000 lb; weight less fuel and payload, 88,000 lb.

Payload accommodation: Cabin volume, 5,150 cu ft; baggage and freight volume, 750 cu ft; cabin length (incl. pantry and lavatory), 76ft; max. width, 11ft 7in; max. height, 6ft 8in; max. usable floor area, 810 sq ft; dimensions of largest doors, 70in × 31.5in.

Fuel capacity: 6,690 Imp. gal (8,034 U.S. gal).

Performance: Cont. cruising speed, 315 kt (362 m.p.h.) at 20.250ft and 135,000 lb; corres. specific fuel consumption, 0.647 lb/b.h.p./hr; balanced field length at max. take-off weight, S.L., I.S.A., 6,320ft; at S.L., I.S.A. +15 deg C, 7,350ft; at 5,000ft, I.S.A., 8,020ft; landing distance from 50ft, 5,200ft; range A (max. payload), 2,945 n.m. (3,385 st.m.); range B (max. fuel), optimum cruise, 3,690 n.m. (4,250 st.m.); corres. payload, 13,480 lb; corres. cruising speed, 285 kt (328 m.p.h.).

Britannia 250 This is the generic type designation of the military version of the Britannia, 23 of which are being delivered to R.A.F. Transport Command by Bristol, and by Short Brothers and Harland from the assembly line operated at Belfast since December, 1953.

Britannia 252 This is a passenger-cargo version, three of which were originally ordered for Government trooping work by the M. of S. for operation by British independent airlines. In the spring of 1959, as a result of a change in policy, these aircraft were transferred to R.A.F. Transport Command. Maximum payload is 28,000 lb, including 84 passengers and freight which is accommodated on the forward strengthened portion of the floor, and loaded via an enlarged door.

Powerplant: As for 320.

Weights: As for 320, except: capacity payload, 33,100 lb; weight less fuel and payload, 94,900 lb.

Payload accommodation: As for 320, except: forward door, 6ft 3in × 7ft 9in; max. seats, 149.

Fuel capacity: As for 320.

Performance: As for 320, except range B payload is 21,700 lb.

Britannia 253 This is essentially an all-cargo transport, built entirely to military requirements. Twenty are being delivered to R.A.F. Transport Command. A special feature is the heavy "floating" floor designed by Shorts (*Flight*, August 9, 1957). The forward freight door has the same dimensions as that of the 252. Max. payload is 34,000 lb.

Powerplant: As for 320, except that the military designation of the Proteus 765 with water injection is 255.

Weights: As for 320, except: max. freight payload, 37,400 lb; weight less fuel and payload, 90,600 lb.

Payload accommodation: As for 320, except: underfloor freight volume, 791 cu ft.

Fuel capacity: As for 320, plus 48 Imp. gal water (injection).

Performance: As for 320, except: with water injection take-off field lengths for the respective conditions are 7,800ft, 8,700ft, 10,650ft. Also, range B payload (all freight) is 26,000 lb.

Britannia 300 Three of these were built, one for the M. of S. and two, designated 302, which were bought by Aeronaves de Mexico. The 300 has the capacity and power of the 305, but less tankage—6,690 Imp. gal instead of 8,580 Imp. gal, and a max. take-off weight of 170,000 lb.

Britannia 305 A total of five of this model were built; two are in service with Air Charter, and two with Transcontinental (**308**). They are in all major respects comparable with the 310 model, the designation 305 being applied when, in 300 form, they were modified to bring them as closely as possible to 310 standard, including in particular the addition of the 310 wing with 8,580 Imp. gal. As for 320, except:—

Weights: Capacity payload, 33,100 lb; weight less fuel and payload, 94,900 lb.

Britannia 310 This is the standard long-range version as operated by B.O.A.C. (17 312s); El Al (four 313s); C.P.A.L. (six 314s and two 320s); British and Commonwealth (Hunting-Clan), (two 317s); Cubana (four 318s). Production has now given way to the improved 320.

The 310, first of which was flown on December 31, 1956, entered service across the North Atlantic with B.O.A.C. on December 19, 1958.

All data as for 320, except: capacity payload, 34,900 lb; weight, less fuel and payload, 93,100 lb, and range B payload, 23,500 lb.

Britannia 320 This is the standard production commercial Britannia, a development of the 310 incorporating numerous detail engineering improvements resulting from 310 operating experience, and all alterations necessary for compliance with American F.A.A. requirements. Of six built, two have been bought by Canadian Pacific Airlines. Two of Cubana's four 318s are 320-standard, as also are one B.O.A.C. 312 and one El Al 313. Basic price: £1.07m. *Flight* description, July 25, 1958. Airline operators' reference drawing page 600.

Powerplant: Four Bristol Proteus 765 turboprop engines of 4,450 e.h.p. driving de Havilland Hydromatic four-blade 16ft propellers.

Dimensions: Span, 142ft 3.5in; length, 124ft 3in; height empty, 37ft 6in; wing area, 2,075 sq ft; aspect ratio, 9.76.

Weights: Max. take-off, 185,000 lb; landing, 137,000 lb; zero fuel, 128,000 lb; capacity payload (ZFW-limited), 34,369 lb; weight less fuel and payload, 93,631 lb.

Payload accommodation: Cabin volume, 5,877 cu ft; baggage and freight volume, 910 cu ft; cabin length, 86ft 3in; max. width, 11ft 7in; max. height, 6ft 8in; max. usable floor area, 883 sq ft; dimensions of largest door(s) 70in × 31.5in; max. seats, 149.

Fuel capacity: 8,580 Imp. gal (10,300 U.S. gal).

Performance: Cont. cruising speed, 345 kt (385 m.p.h.) at 22,000ft and 150,000 lb; corres. specific fuel consumption, 0.585 lb/b.h.p./hr; balanced field length at max. take-off weight, S.L., I.S.A., 8,150ft; at S.L., I.S.A. +15 deg C, 9,600ft; at 5,000ft I.S.A., 11,800ft; landing distance from 50ft, 6,000ft, range A (max. payload) 3,620 n.m. (4,160 st.m.); range B (max. fuel) optimum cruise, 4,530 n.m. (5,000 st.m.); corres. payload, 23,000 lb; corres. cruise speed 310 kt (357 m.p.h.).

Bristol 205 In the project stage still, the 205 short-range jet is a smaller development of the "B.E.A. Jet" Type 200 project of 1956.

Bristol 216 No information has been released on this combined Anglo-French venture, for which an order for 15-25 might be placed by Silver City for the Channel Air Ferry. It is reported that the Bristol-Bréguet is to be powered by two Rolls-Royce Darts and will accommodate six cars and their passengers or—with uprated Darts—a considerable number of passengers. Cruising speed is said to be less than 300 m.p.h. and operating cost of the passenger version less than one penny per passenger-mile. Silver City have said that their new aircraft should be in service by 1962 and that it will be "inexpensive." The price is expected to be in the region of £250,000.

CANADAIR *Canadair Ltd., Post Office Box 6087, Montreal, Canada.*

DC-4M A pressurized, Merlin-engine conversion of the Douglas DC-4/C-54, the DC-4M was named North Star by T.C.A., who first operated it in 1947 and who still own 21. The DC-4M was bought also by B.O.A.C. in March 1949; they named it Argonaut, and three remain in Corporation service. Other operators are E.A.A.C., 3 (ex-B.O.A.C.), and Overseas Aviation, 4 (ex-B.O.A.C.).

The DC-4M was described in *Flight* on June 26, 1947.

Powerplant: Four Rolls-Royce Merlin Mk 626 of 1,760 b.h.p. driving Hamilton Standard 13ft 1in propellers.

Dimensions: Span, 117ft 6in; length, 93ft 7½in; height, 27ft 6in; wing area, 1,457 sq ft.

Weights: Max. take-off, 82,300 lb; landing, 70,000 lb; zero fuel,

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

66,000 lb; capacity payload, 17,156 lb; weight less fuel and payload, 46,728 lb.

Payload accommodation: Max. seats, 55; baggage and freight volume, 698 cu ft.

Fuel capacity: 3,226 Imp. gal (3,870 U.S. gal).

Performance: Cont. cruising speed 286 kt (329 m.p.h.) at 10,000ft and 70,000 lb; range A (max. payload), 2,075 n.m. (2,385 st.m.); range B (max. fuel), 3,240 n.m. (3,730 st.m.).

CL-44D About to fly at Montreal is the first CL-44D, a design which promises outstanding economy and flexibility as a large cargo transport or convertible cargo/passenger carrier. Based on the Bristol Britannia and its Canadair CL-28 maritime reconnaissance derivative, the Rolls-Royce Tyne-powered CL-44 has an exceptional payload-range capacity and should have a lower operating cost per ton-mile than any other aircraft on order by the airlines; Canadair claim 40 per cent better than the best cargo aircraft now operating.

An earlier criticism of the CL-44—that the side-door loading arrangements did not make the best advantage of the fuselage capacity—was answered by a version, announced in 1959, with a swinging tail section for direct aft loading. The fuselage will now accept a single unit 85ft long, 11ft wide and 6½ft high, and weighing 65,200 lb. It is this version, the CL-44D-4 (also known as the CL-44G), for which Seaboard & Western and Flying Tiger respectively placed orders in May 1959 for five aircraft (with an option on five) and ten aircraft for delivery and service in 1961. The R.C.A.F. have ordered a further 12 of the military side-loading version, the CC-106.

Also offered is the CL-44D-5, a "U.S. domestic" version structurally strengthened to permit payload to be increased by 13,000 lb. Zero fuel and landing weights are up by 10,000 lb, and the centre-section bay tankage is deleted.

Looking ahead, by taking advantage of Tyne power increases the basic CL-44 should eventually carry payloads of up to 100,000 lb, grossing around 230,000 lb. Such a development would be designated CL-44E.

Description in *Flight:* December 12, 1958. (A cutaway drawing appears on pages 588-589.) Price with spares: about £1.6m.

Powerplant: Four Rolls-Royce Tyne 12 Mk 515/10 of 5,730 e.h.p. driving de Havilland 16ft 4/7,000/6 propellers.

Dimensions: Span, 142ft 3.6in; length, 136ft 8in; height, 38ft 7in; wing area, 2,075 sq ft.

Weights: Max. take-off, 205,000 lb; landing, 165,000 lb; zero fuel, 155,000 lb; capacity payload (cargo), 65,200 lb, (passenger), 37,630 lb; weight less fuel and payload (cargo), 89,800 lb, (passenger), 105,700 lb.

Payload accommodation: Cabin volume (less flight deck), 6,239 cu ft; baggage and freight volume, 1,011 cu ft; cabin length, 98ft 7in; max. width, 11ft 5in; max. height, 6ft 9in; max. usable floor area (less flight deck), 1,075 sq ft; max. number of seats, 189.

Fuel capacity: 10,150 Imp. gal (12,190 U.S. gal).

Performance: Cont. cruising speed 340 kt (392 m.p.h.) at 20,000ft and 170,000 lb weight; corres. s.f.c. 0.385 lb/e.h.p./hr; balanced field length at max. take-off weight, S.L., I.S.A., 7,660ft; landing distance from 50ft, 6,780ft; range A (max. payload, no allowances), 3,110 n.m. (3,570 st.m.) (cargo), 4,300 n.m. (4,950 st.m.) (pass.); range B (max. fuel, no allowances), 5,480 n.m. (6,300 st.m.).

Canadair 540 This is the new production 540, built by Canadair at Montreal on jigs shipped from its sister company Convair, powered by Napier Elands. By increasing passenger cabin length, standard accommodation for 48 seats instead of 44 is available, and engineering improvements include better braking, increased fuel capacity and faster undercarriage retraction. See also Convair 540, page 592.

Ten Canadair 540s are in production for the R.C.A.F., designated CC-109(CL-66B). Delivery to the R.C.A.F. is due to start this autumn.

Powerplant: Two Napier Eland 504A turboprops each producing 3,500 e.h.p. for take off (at S.L., I.S.A.) and driving de Havilland 4/6,000/6 four-blade, 13ft 6in diameter propellers.

Canadair 540 (Napier Eland 504A turboprops)

Dimensions: Span, 105ft 4in; length, 79ft 2in (with radome, 81ft 6in); height, 28ft 1.6in; wing area, 920 sq ft.

Weights: Max. take-off, 53,200 lb; landing, 50,670 lb; zero fuel, 47,000 lb; max. weight payload, 12,986 lb; max. space payload, 11,900 lb; weight less fuel and payload, 34,014 lb.

Payload accommodation: Cabin volume (less flight deck), 2,515 cu ft; baggage and freight volume, 402 cu ft; cabin length, 54ft 10in; max. width, 8ft 10⅓in; max. height, 6ft 7in; max. usable floor area (less flight deck), 396 sq ft; dimensions of largest doors, 72in × 120in (military cargo); max. seats, 48 first-class, 58 economy.

Fuel capacity: 1,690 Imp. gal (2,032 U.S. gal, or 2,580 U.S. gal with optional bag tanks).

Performance: Cont. cruising speed, 282 kt (325 m.p.h.) at 20,000ft and 46,000 lb; balanced field length, max. take-off weight, S.L., I.S.A., 4,550ft; landing distance from 50ft, 4,020ft; range A (max. payload), 785 n.m. (905 st.m.); range B, 1,800 n.m. (2,070 st.m.) at 279 kt (322 m.p.h.) with 5,572 lb payload.

C.A.S.A. *Construcciones Aeronauticas, S.A., Calle del Rey Francisco, Madrid.*

CASA 207 Azor A replacement for the DC-3, and possibly also for Bristol Freighters and Languedocs in service with Iberia and Aviacion y Comercio, the prototype Azor first flew in September 1955. Airline orders have not so far been forthcoming, although the project is still active. Suggestions have been made that the Azor might be re-engined with Napier Eland turboprops as the **209.**

Powerplant: Two Bristol Hercules 730s of 2,040 b.h.p. each.

Dimensions: Span, 91ft 2in; length 68ft 5in; height 25ft 5in, wing area, 924 sq ft.

Weights: Max. take-off, 37,480 lb; landing, 33,960 lb; zero fuel, 31,500 lb; capacity payload, 9,000 lb; weight less fuel and payload, 23,670 lb.

Payload accommodation: Cabin volume (less flight deck), 1,630 cu ft; baggage and freight volume, 285 cu ft; cabin length, 37ft 11in; max. width, 7ft 10in; max. height, 6ft 4in; max. usable floor area (less flight deck), 240 sq ft; dimensions of door, 59 × 31.5in; max. seats, 40.

Fuel capacity: 1,030 Imp. gal (1,235 U.S. gal).

Performance: Cont. cruising speed 200 kt (230 m.p.h.) at 6,500ft and 37,480 lb; fuel consumption in this condition, 875 lb/hr; balanced field length at max. take-off weight, S.L., I.S.A., 3,360ft; landing distance from 50ft, 2,840ft; range A (max. payload), 1,090 n.m. (1,250 st.m.).

CHINESE STATE AIRCRAFT INDUSTRY—see under Peking.

CONVAIR *Convair Division of General Dynamics Corporation, San Diego 12, California, U.S.A.*

Consolidated PBY-5A (Catalina) About 56 of these amphibians—conversions of U.S. Navy PBY-5s, R.A.F. Catalinas and R.C.A.F. Cansos—are still in service, notably with Pacific Western, Panair do Brasil and TransAir (Canada).

Powerplant: Two Pratt & Whitney R-1830s of 1,200 b.h.p. each.

Salient data: Span, 104ft; length, 63ft 10in; wing area, 1,400 sq ft; gross weight, 34,000 lb; cruising speed at 10,000ft, 108 kt (125 m.p.h.); range, 2,520 st.m.

Convair 240 The Convair 240 was one of the first up-to-date general-purpose transports to be offered after the 1939-45 war. The series originated from the gull-winged Convair Model 110, which first flew on July 9, 1946. The 240 was advertised as a "300 m.p.h. airliner" for short and medium-range routes, and a steady process of modification and modernization kept the now famous Convair-liner series in production until 1958, when the tools and jigs were sent to Montreal for production of the Canadair 540. Altogether, including United States military orders, sales of the Convair-liner family reached 1,037 in an unbroken production run from 1947 and the aircraft has seen service with 46 airlines.

The prototype CV-240 flew on March 16, 1947, and the first deliveries, to American Airlines, were made less than a year later; services started on June 1, 1948. The design achieved considerable success, and was ordered in quantity by American, Western, PanAm and Continental, and in Europe by K.L.M., Sabena and Swissair. Some 129 are still in service. The fuselage was pressurized and offered with either rear or fuselage-side passenger loading. Until June 1948, the basic price was less than £100,000. Used price today is about £77,000.

Powerplant: Two Pratt and Whitney R-2800-CA18 of 2,400 b.h.p. each for take-off driving Hamilton 13ft 1in propellers.

Dimensions: Span, 91ft 9in; length, 74ft 8in; height, 26ft 11in; wing area, 817 sq ft.

Weights: Max. take-off, 41,790 lb; landing, 39,800 lb; zero fuel, 38,600 lb; capacity payload, 9,600 lb; weight less fuel and payload, 29,000 lb.

Payload accommodation: Baggage and freight volume, 419.7 cu ft; cabin length, 33ft 5in; max. width, 8ft 10.5in; max. height, 6ft 7in; dimensions of largest door, 83in × 36in; max. seats, 40.

Fuel capacity: 1,283 Imp. gal (1,550 U.S. gal) plus 12½ Imp. gal (15 U.S. gal) water-methanol.

Performance: Continuous cruising speed 247 kt (284 m.p.h.) at 20,000ft; field length (CAR 4b, Part 40) S.L., I.S.A., 4,300ft; landing distance from 50ft, 3,960ft; range A (max. payload), 348 n.m. (400 st.m.) with 1,650 lb reserve fuel; range B (max. fuel), 890 n.m. (1,025 st.m.) with 1,650 lb reserve fuel; corres. payload, 6,250 lb; corres. block speed, 216 kt (248 m.p.h.).

Convair 340 Direct successor to the Convair 240, the 340 had a longer fuselage, additional wing area, higher maximum weight and greater power. There were a number of other design improvements, including a new flap arrangement and an entirely new interior. The 340 was equipped with folding stairs in an entrance on the port, instead of the

(*Continued on page 592, after double-page drawings*)

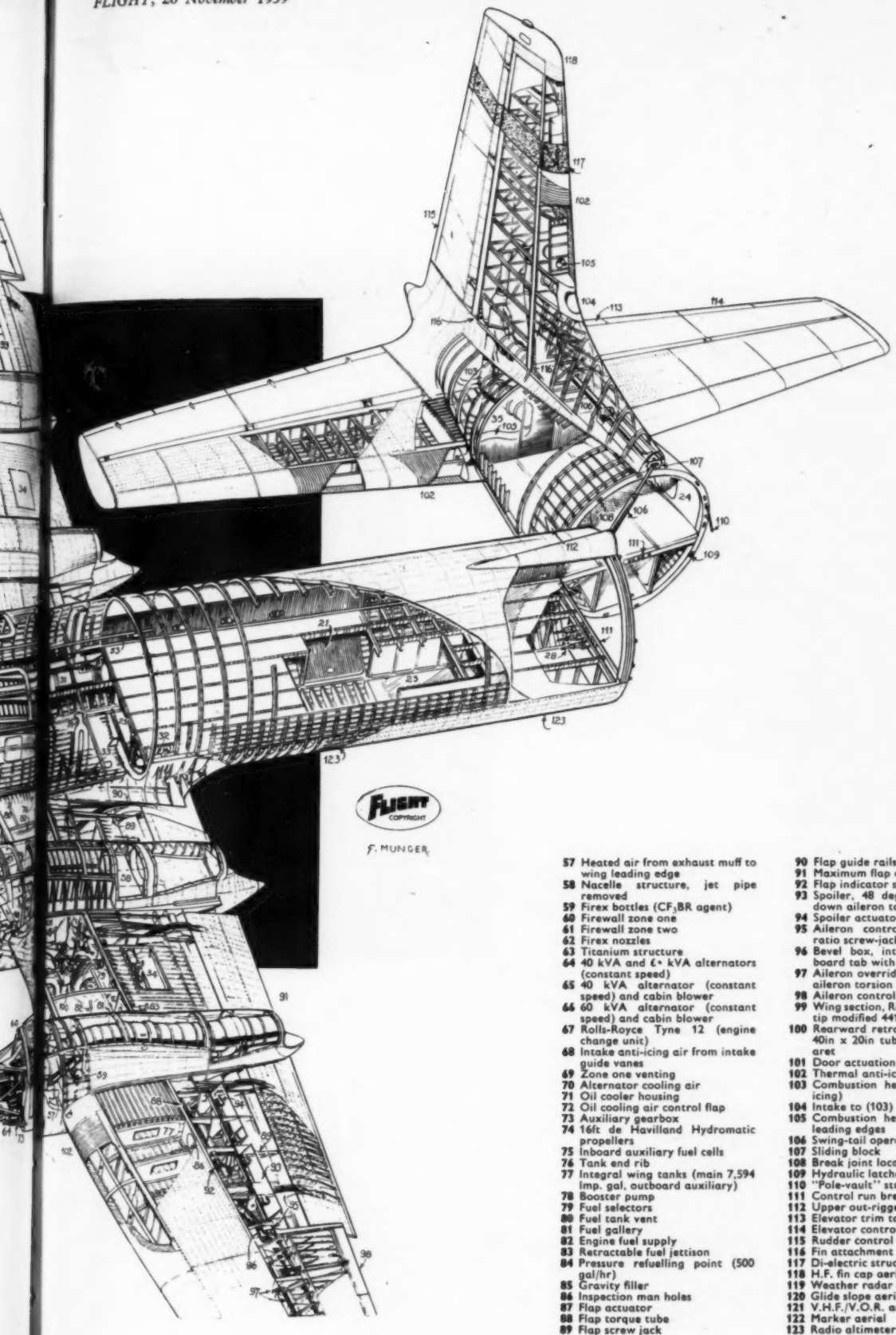
COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

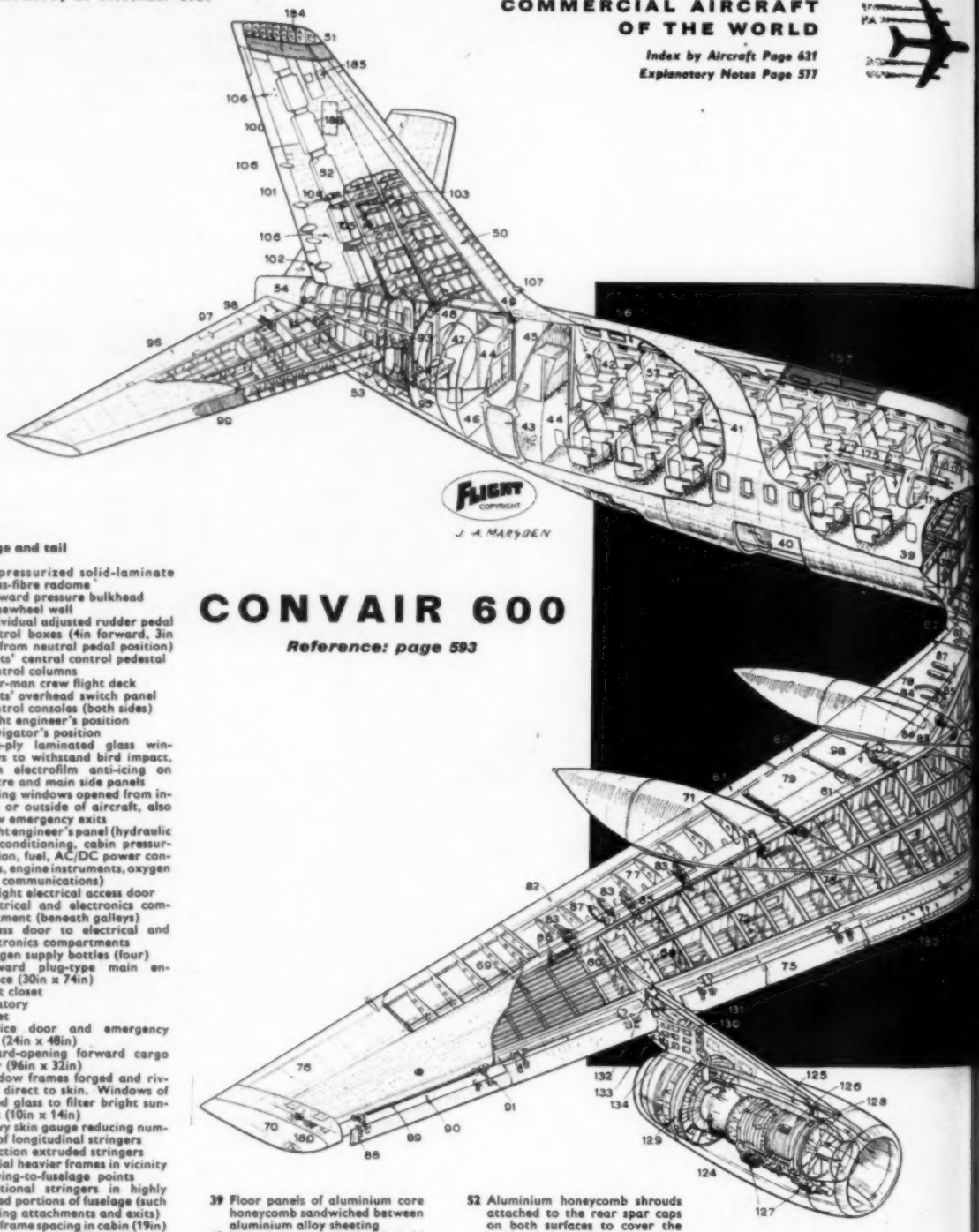
CANADAIR CL-44D-4

Reference: page 587

1 Hinged di-electric nose
2 Arcouste A.P.U.
3 A.P.U. exhaust door actuator
4 A.P.U. delivery duct
5 A.P.U. venting system
6 A.P.U. Firex system
7 Front pressure dome
8 Pre-closing doors
9 Nose wheel steering control
10 Laminated electrically anti-iced windscreen
11 Tubeless tyres, 32in x 8.8in, 117ft turning circle
12 Systems generator
13 Navigator
14 Radio racks
15 Main electrics distribution panel
16 Junction boxes
17 Ditching hatch
18 Periscopic sextant
19 Static apertures
20 Forward cargo door (crew door integral)
21 Baggage doors
22 Forward baggage hold
23 Rear baggage hold
24 Emergency doors
25 Toilet collector tank
26 Toilet discharge valve
27 Ice protection strip
28 Control torque tubes
29 Wing/fuselage main frames
30 Seat/cargo rails
31 Water tanks (133 Imp. gal)
32 Oxygen bottles
33 Baggage hold Firex bottles
34 Dinghy (20 man) stowage
35 Rear pressure bulkhead
36 Intakes electrically anti-iced
37 Ram air to cabin air system, wing anti-icing and zone two venting
38 Air to oil cooler and bay venting
39 Godfrey cabin blower
40 Blower intake
41 Blower delivery to heat exchanger
42 Blower air spill
43 Heat exchanger (hot air)
44 Ram air to (43)
45 Heated air from exhaust muff to (43)
46 Hot air to cabin
47 Heat exchanger (cold air)
48 Refrigeration turbine
49 Cold air to cabin
50 Cabin air mixing
51 Conditioned air to cabin
52 Cabin air extraction
53 Cold air distribution
54 Conditioned air to flight deck
55 Ram air for wing anti-icing and zone two venting
56 Air to rear end of exhaust muff



57 Heated air from exhaust muff to wing leading edge
58 Nacelle structure, jet pipe removed
59 Firex bottles (CF_3BR agent)
60 Firewall zone one
61 Firewall zone two
62 Firex nozzles
63 Titanium structure
64 40 kVA and £• kVA alternators (constant speed)
65 40 kVA alternator (constant speed) and cabin blower
66 60 kVA alternator (constant speed) and cabin blower
67 Rolls-Royce Tyne 12 (engine change unit)
68 Intake anti-icing air from intake guide vanes
69 Zone one venting
70 Alternator cooling air
71 Oil cooler housing
72 Oil cooling air control flap
73 Auxiliary gearbox
74 16ft de Havilland Hydromatic propellers
75 Inboard auxiliary fuel cells
76 Tank end rib
77 Integral wing tanks (main 7,594 Imp. gal, outboard auxiliary)
78 Booster pump
79 Fuel selectors
80 Fuel tank vent
81 Fuel gallery
82 Engine fuel supply
83 Retractable fuel jettison
84 Pressure refuelling point (500 gal/hr)
85 Gravity filler
86 Inspection man holes
87 Flap actuator
88 Flap torque tube
89 Flap screw jack
90 Flap guide rails
91 Maximum flap angle 45 deg
92 Flap indicator switch
93 Spoiler, 48 deg up with max. down aileron tab
94 Spoiler actuator
95 Aileron control tab variable-ratio screw-jack
96 Bevel box, interconnecting inboard tab with rudder
97 Aileron override limit stops and aileron torsion bars
98 Aileron control tab
99 Wing section, Root NACA 25017, tip modified 4413
100 Rearward retracting main gear 40in x 20in tubeless tyres Maxaret
101 Door actuation
102 Thermal anti-iced leading edges
103 Combustion heaters (tail anti-icing)
104 Intake to (103)
105 Combustion heater delivery to leading edges
106 Swing-tail operating jack
107 Sliding block
108 Break joint locating points
109 Hydraulic latches (6 off)
110 "Pole-vault" strut
111 Control run break
112 Upper out-rigged hinge
113 Elevator trim tab
114 Elevator control tab
115 Rudder control tab
116 Fin attachment
117 Di-electric structure
118 H.F. fin cap aerial
119 Weather radar scanner
120 Glide slope aerial
121 V.H.F./V.O.R. aerial
122 Marker aerial
123 Radio altimeter aerials

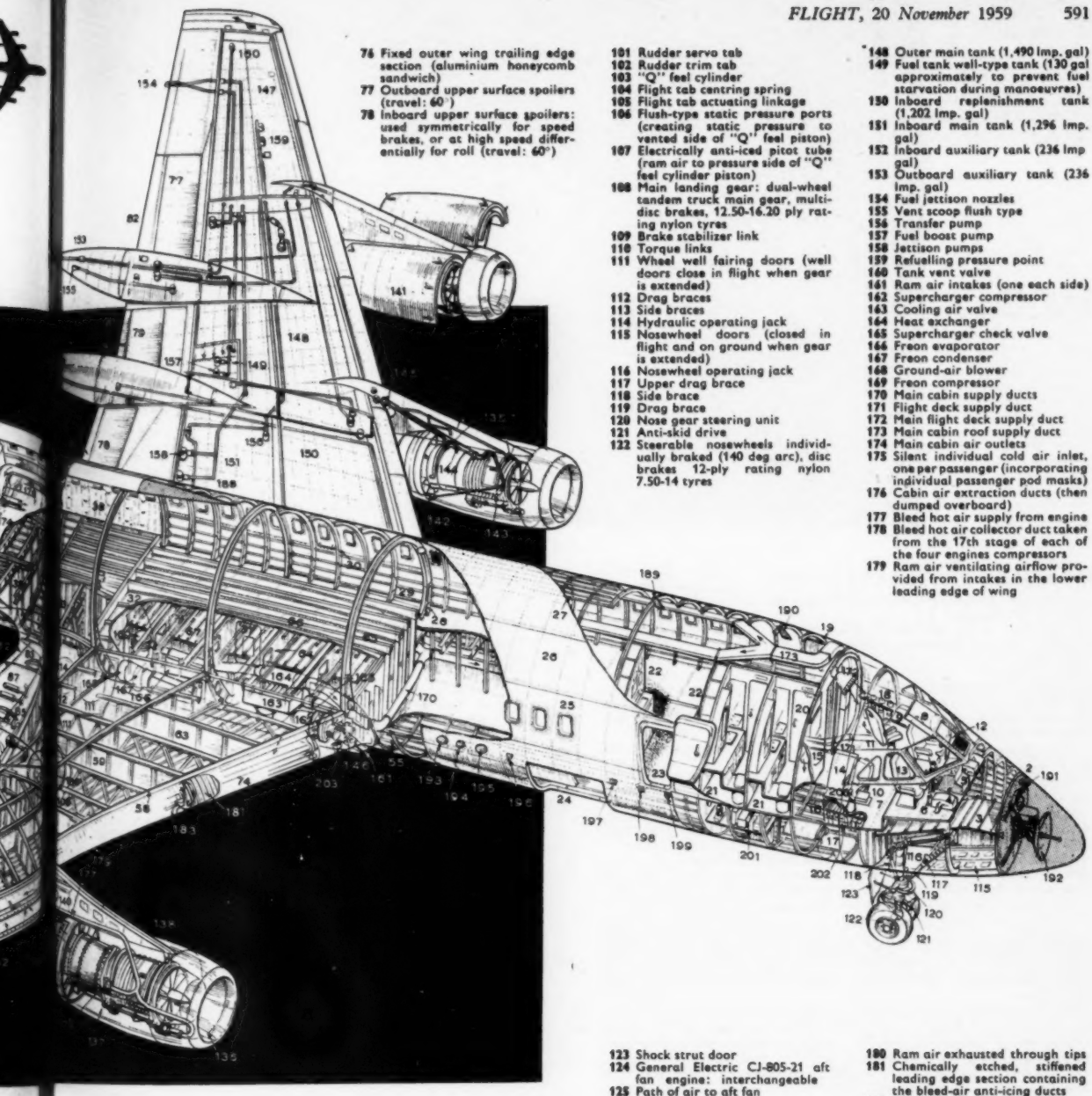


CONVAIR 600

Reference: page 593

Fuselage and tail

1 Unpressurized solid-laminate glass-fibre radome
2 Forward pressure bulkhead
3 Nosewheel well
4 Individual adjusted rudder pedal control boxes (4in forward, 3in aft from neutral pedal position)
5 Pilots' central control pedestal
6 Control columns
7 Four-man crew flight deck
8 Pilots' overhead switch panel
9 Control consoles (both sides)
10 Flight engineer's position
11 Navigator's position
12 Five-ply laminated glass windows to withstand bird impact, with electrofilm anti-icing on centre and main side panels
13 Sliding windows opened from inside or outside of aircraft, also crew emergency exits
14 Flight engineer's panel (hydraulic air conditioning, cabin pressurization, fuel, AC/DC power controls, engine instruments, oxygen and communications)
15 In-flight electrical access door
16 Electrical and electronics compartment (beneath galleys)
17 Access door to electrical and electronics compartments
18 Oxygen supply bottles (four)
19 Forward plug-type main entrance (30in x 74in)
20 Coat closet
21 Lavatory
22 Buffet
23 Service door and emergency exit (24in x 48in)
24 Inward-opening forward cargo door (96in x 32in)
25 Window frames forged and riveted direct to skin. Windows of tinted glass to filter bright sunlight (10in x 14in)
26 Heavy skin gauge reducing number of longitudinal stringers
27 Z-section extruded stringers
28 Special heavier frames in vicinity of wing-to-fuselage points
29 Additional stringers in highly loaded portions of fuselage (such as wing attachments and exits)
30 Belt-frame spacing in cabin (19in)
31 Emergency exits (20in x 36in)
32 Air conditioning and pressurization equipment bay beneath wing centre section (unpressurized)
33 Main wheel well with dividing deep-keel member
34 Transverse built-up floor beams (tee caps and stiffened web) without use of vertical floor support members reduces landing shock in wheels-up landing
35 Longitudinal seat support beams also stabilize floor beams in the fore and aft direction
36 Hydraulic and pneumatic compartment (pressurized)
37 Hydraulic and pneumatic compartment access door (46inx18in)
38 Sound insulation blankets clipped to beltframes
39 Floor panels of aluminium core honeycomb sandwiched between aluminium alloy sheeting
40 Inward-opening rear freight hold doors (96in x 32in and 34in x 39in respectively)
41 Standard all-coach 121-passenger seating layout
42 Rear main entrance
43 Rear service and emergency door
44 Buffet
45 Coat closet
46 Toilets port and starboard
47 Rear pressure bulkhead
48 Three-spar box beam full-cantilever vertical fin
49 Six fin-attachment lugs consist of aluminium alloy forgings providing shearbolt connections to fuselage frames
50 Three-piece detachable, non-structural leading edge
51 Removable aluminium alloy tip
52 Aluminium honeycomb shrouds attached to the rear spar caps on both surfaces to cover the rudder balance boards and to act as an aerodynamic seal
53 Rear fuselage afterbody housing the movable horizontal tail
54 Tail cone
55 Machined external longeron between front and rear cargo compartments ensures structural continuity in area around wing cut-outs and main wheel wells
56 Light luggage racks containing emergency oxygen sets
57 Passenger seats with built-in folding tray for food service and/or writing table
58 Front spar except for splices, continuous from tip to tip, supports engine pylons, anti-icing extendable leading edge
59 Centre spar similar to the front spar, but terminating at web outboard of outboard pylon (60)
60 Rails become heavy stringers continuing to the wingtip rib
61 Rear spar: construction similar to front spar except for splices, is continuous through fuselage, supports flaps, ailerons and spoilers, also carries the main landing gear forward trunnion
62 Auxiliary wing spar: carries rear landing gear trunnion
63 Web-type ribs alternate with plate ribs, full intercostalling is used on ribs that have high concentrated loads from pylon flaps, ailerons, etc.



76 Fixed outer wing trailing edge section (aluminium honeycomb sandwich)
77 Outboard upper surface spoilers (travel: 60°)
78 Inboard upper surface spoilers: used symmetrically for speed brakes, or at high speed differentially for roll (travel: 60°)

101 Rudder servo tab
102 Rudder trim tab
103 "Q" feel cylinder
104 Flight tab centring spring
105 Flight tab actuating linkage
106 Flush-type static pressure ports (creating static pressure to vented side of "Q" feel piston)
107 Electrically anti-iced pitot tube (ram air to pressure side of "Q" feel cylinder piston)
108 Main landing gear: dual-wheel tandem truck main gear, multi-disc brakes, 12.50-16.20 ply rating nylon tyres
109 Brake stabilizer link
110 Torque links
111 Wheel well fairing doors (well doors close in flight when gear is extended)
112 Drag braces
113 Side braces
114 Hydraulic operating jack
115 Nosewheel doors (closed in flight and on ground when gear is extended)
116 Nosewheel operating jack
117 Upper drag brace
118 Side brace
119 Drag brace
120 Nose gear steering unit
121 Anti-skid drive
122 Steerable nosewheels individually braked (140 deg arc), disc brakes 12-ply rating nylon 7.50-14 tyres

148 Outer main tank (1,490 Imp. gal)
149 Fuel tank wall-type tank (130 gal approximately to prevent fuel starvation during manoeuvres)
150 Inboard replenishment tank (1,202 Imp. gal)
151 Inboard main tank (1,296 Imp. gal)
152 Inboard auxiliary tank (236 Imp gal)
153 Outboard auxiliary tank (236 Imp. gal)
154 Fuel jettison nozzles
155 Vent scoop flush type
156 Transfer pump
157 Fuel boost pump
158 Jettison pumps
159 Refuelling pressure point
160 Tank vent valve
161 Ram air intakes (one each side)
162 Supercharger compressor
163 Cooling air valve
164 Heat exchanger
165 Supercharger check valve
166 Freon evaporator
167 Freon condenser
168 Ground-air blower
169 Freon compressor
170 Main cabin supply ducts
171 Flight deck supply duct
172 Main flight deck supply duct
173 Main cabin roof supply duct
174 Main cabin air outlets
175 Silent individual cold air inlet, one per passenger (incorporating individual passenger pod masks)
176 Cabin air extraction ducts (then dumped overboard)
177 Bleed hot air supply from engine
178 Bleed hot air collector duct taken from the 17th stage of each of the four engines compressors
179 Ram air ventilating airflow provided from intakes in the lower leading edge of wing

44 Four-centre transverse spars at approximately equal intervals between front and rear spars
65 Fore and aft beams: cabin floor attaches directly to these, eliminating floor beams in the fuselage beltframes
66 Spanwise skin splice extends from front and rear spar on centre-section centre-line
67 Centre tie box centre section is sealed and capable of carrying fuel (2,580 Imp. gal)
68 Fuel tanks are formed integral with Scotch-Weld leakproof wing structure and separated by fuel-type bulkheads
69 Mill-tapered "Z" sectioned extruded stringers on upper and lower wing skinning
70 Four-point detachable wing-tip
71 Aerodynamic anti-shock bodies
72 Fuel tank access doors
73 Access holes in main inter spar
74 Chemically-etched, stiffened leading edge containing bleed air, anti-icing ducts
75 Leading edge extended slats containing anti-icing

79 Balance board servo-tab-operated inboard ailerons inter-connected with spoilers
80 Aileron trim tab
81 Aileron servo tab
82 Double-slotted Fowler-type inner and outer flaps
83 Flap extension rails
84 Flap gearbox and screw jack
85 Flap torque tube and gearboxes
86 Asymmetric flap shut-off unit
87 Spoiler actuator jacks
88 Slat jack
89 Torque tube
90 Engagement hook
91 Slat screw jack
92 Tailplane pivot point (2½° up, 15° down)
93 Tailplane follow-up mechanism
94 Follow-up shaft
95 Tailplane control torque tube
96 Servo-tab operated elevators
97 Elevator servo tab
98 Gust damper (preventing damage to the surfaces by wind)
99 Leading-edge electrical anti-icing heating strips
100 Servo-tab-operated mass balanced rudder

123 Shock strut door
124 General Electric CJ-805-21 aft fan engine: interchangeable
125 Path of air to aft fan
126 Engine oil tank
127 Accessory gearboxes
128 Front engine mounting
129 Rear engine support yoke
130 Engine pod support beam
131 Engine brace to wing
132 Pod support beam to wing
133 Fire-detector panel
134 "Two-shot" fire extinguisher
135 Fire extinguisher nozzles
136 Detachable nose cone, anti-iced using turbine bleed air
137 Aluminium skins used below centre line
138 Titanium skins are used above centre line isolating wing from pod in case of fire
139 Gate (target type) thrust reverser (shown in reverse thrust position)
140 Thrust reverse actuator
141 Hinged panels giving complete access to engine
142 Thrust reverse control valve
143 Fuel shut off and power control torque box
144 Engine control cable run
145 Pylon torque box
146 Pressure seals for engine control runs
147 Outer replenishment tank (532 Imp. gal)

180 Ram air exhausted through tips
181 Chemically etched, stiffened leading edge section containing the bleed-air anti-icing ducts
182 Perforated leading-edge duct
183 Hot air from (182) passes over leading edge in the etched grooves then discharged beneath wing
184 H.F. communications aerial housed in a ten-inch wide fibre-glass structure, installed to serve as an antenna insulation
185 H.F. coupler
186 V.H.F. navigation aerial
187 A.D.F. sense aerial
188 No. 2 V.H.F. aerial
189 No. 3 V.H.F. aerial
190 No. 2 D.M.E.T.
191 Glidepath aerial
192 Cloud-collision warning radar
193 A.D.F. loop
194 Marker
195 A.D.F. loop
196 A.T.C. radar beacon
197 No. 1 V.H.F. communication aerial
198 A.T.C. radar beacon
199 No. 1 D.M.E.T.
200 AC/DC distributors
201 Transformer rectifiers
202 Directional gyros, autopilot, etc., and tape reproducer, Doppler computer provisional
203 Landing lights (port and stbd.)

Convair 880 (G.E. CJ-805-3 turbojets)

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

starboard side as on the 240. The first 340 contracts were signed early in 1951 and the prototype made its first flight on October 5, 1951. Over 200 were built for civil use and 190 are still in service with 20 airlines. The current market price is about £133,000.

Powerplant: Two Pratt and Whitney R-2800-CB16/17 of 2,500 b.h.p. each driving Hamilton 13ft 6in propellers.

Dimensions: Span, 105ft 4in; length, 79ft 2in; height empty, 28ft 2in; wing area, 920 sq ft.

Weights: Max. take-off, 47,000 lb; max. landing, 46,500 lb; zero fuel, 45,000 lb; capacity payload, 13,900 lb; weight less fuel and payload, 31,100 lb.

Payload accommodation: Baggage and freight volume, 514 cu ft; cabin length, 36ft 7in; max. width, 8ft 10½in; max. height, 6ft 7in; dimensions of largest door, 83in × 36in; max. seats, 44.

Fuel capacity: 1,460 Imp. gal + 12½ Imp. gal water-methanol.

Performance: Cont. cruise speed, 246 kt (284 m.p.h.) at 20,000ft (1,160 b.h.p. per engine); balanced field length (CAR 46 Part 40), max. take-off weight, sea level, I.S.A., 4,640ft; landing distance from 50ft, 3,960ft; range A (max. payload), 218 n.m. (250 st.m.) with 1,650 lb reserve fuel; range B (max. fuel), 1,630 n.m. (1,875 st.m.) with 1,650 lb reserve fuel.

Convair 440 As was to be expected, the 340 all-up weight did not long remain at 47,000 lb, and in the CV-440 Metropolitan it reached 49,700 lb. Soundproofing was considerably improved, and a new thrust-augmenting exhaust system, with its rectangular exit nozzle above the wing trailing edge, is a distinguishing feature of the 440. The first flight of this version was made on December 16, 1955. The majority of the 153 Metropolitans built are still in service, the principal operators being Eastern (20), R.E.A.L. (15), Sabena (12), S.A.S. (20) and Swissair (11). The aircraft was described in *Flight*, July 6, 1956. The current market price is about £190,000.

Powerplant: As 340.

Dimensions: As 340 except length, 81ft 6in (includes nose radar).

Weight: Max. take-off, 49,700 lb; landing, 47,650 lb; zero fuel, 47,600 lb; capacity payload, 14,200 lb; weight less fuel and payload, 32,800 lb.

Payload accommodation: As 340.

Fuel capacity: As 340.

Performance: Continuous cruising speed, 250 kt (289 m.p.h.) at 20,000ft and 45,000 lb; field length (CAR 4b Part 40), max. take-off weight, S.L., I.S.A., 5,680ft; landing distance from 50ft, 4,060ft; range A (max. payload), 409 n.m. (470 st.m.) with 1,650 lb reserve fuel; range B (max. fuel), 1,635 n.m. (1,880 st.m.) with 1,650 lb reserve fuel.

Convair 540 This is the designation given to a CV-340 or CV-440 converted to Napier Eland turboprop power. (New production Eland Convairs are known as *Canadair* 540s—see page 587.)

Five Convair 540s have been built to-date; the original, a 340 converted by Napier at Luton in 1955; a 440 converted by PacAero of Los Angeles and three converted by Canadair. American airworthiness certification was granted to the type-conversion (after a two-year programme involving tests in California of the first two aircraft) on August 22, 1958.

No firm orders for Convair 540 conversions have yet been placed, but the U.S. local-service airline Allegheny has had one in trial service since July 1, 1959; so successful have its scheduled flights been that the airline recently extended the lease.

Cost of conversion is about £160,000. Conversion can be done either by the airlines or by a conversion facility using parts supplied by Canadair and Napier. Extensive sales tours of Europe and the Americas have been undertaken during 1959.

References in *Flight:* July 25, 1958; August 29, 1958; February 6, 1959.

Allison-Convair 340/440 Conversion of Convair 340s and 440s to turboprop power is also offered by the Allison Division of General Motors Corporation. The same powerplant as that of the Lockheed Electra, the Allison 501-D13 driving Aeroproducts 606 propellers, can be fitted. Such a conversion has been made to the Allison "Turboliner," a 1950 CV-240 previously fitted with T-38s.

A similar conversion was undertaken on one of two military CV-340s (YC-131Cs) which had been modified in 1955 to take Allison YT-56s—forerunner of the 501-D13. During 1958 this aircraft completed in 84 days a 1,000 hr development flying programme, "Operation Hourglass." The first converted aircraft is due to be certificated early in 1960. Conversions can be completed in 60 days at a cost of about £175,000. Conversion includes changes to the nacelle and wing structure, a fin extended by 1ft, larger-area rudder, a 40in increase in tailplane span and 17 sq ft increase in elevator area, larger tabs, and re-arranged cockpit instruments and controls.

The aircraft was described in *Flight* of July 25, 1958.

Powerplant: Two Allison 501-D13 turboprops of 3,750 e.h.p. each driving 13ft 6in Aeroproducts 606 propellers.

Dimensions: As Convair 340/440.

Weights: Max. take-off, 53,200 lb; landing, 50,670 lb; zero fuel, 4,500 lb; capacity payload, 11,530 lb; weight less fuel and payload, 33,470 lb.

Payload accommodation: As Convair 340/440.

Fuel capacity: 1,440 Imp. gal (1,730 U.S. gal).

Performance: Cont. cruise speed, 298 kt (343 m.p.h.) at 20,000ft and 48,000 lb; corres. specific fuel consumption, 0.484; balanced field length, max. take-off weight, sea level, I.S.A., 4,750ft; sea level, I.S.A. + 15 deg C, 5,530ft; 5,000ft I.S.A., 6,400ft; landing distance from 50ft, 4,370ft; range A (max. payload), 790 n.m. (910 st.m.); range B (max. fuel), 1,610 n.m. (1,850 st.m.); corres. payload, 8,000 lb; corres. cruise speed, 298 kt (343 m.p.h.).

Convair 880 Convair flew their first CV-880 for the first time on January 27, 1959, beating by three days the target set in June 1956. Embarking on the design of a jet transport later than Boeing or Douglas, Convair went for a medium-range class of jet airliner principally for U.S. domestic operation. They were also able to put the later timescale to good account; the Convair 880 is faster than the 707 or DC-8 by a significant margin. The Convair 600 (see over) is faster still, and almost reaches the peak of economically feasible subsonic performance.

Since the 880 was first announced—as the "Skylark 600," later "Golden Arrow"—the maximum weight has grown steadily and the heavier of the two CV-880s now offered scales 203,400 lb. This is the long-range or international **Model 31** similar in size to the domestic variant, the **Model 22**, but with capacity for an additional 3,100 U.S. gal of fuel in a centre section tank and capable of considerably longer range. This was the version originally ordered by Swissair and S.A.S.

Convair intended right from the start to use the commercial version of the G.E. J79 for their transport (the military version is used in the Convair B-58 Hustler) and this engine, the CJ-805-3, is the powerplant of both the Model 22 and 31. The Convair 600 (see over) has an aft-turbofan development of the same engine.

First orders for the CV-880 were placed in June 1956 by T.W.A. (30) and Delta (10), followed by Capital (originally 10, now believed to be 6),

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

Curtiss 46F (P. & W. R-2800 Double Wasps)

Transcontinental (4), R.E.A.L. (4), C.A.T. of Formosa (1). American Airlines placed an order for 25 in August 1958, subsequently specifying Convair 600s. A provisional F.A.A. certificate of airworthiness was granted in February 1959 and full certification is due in May 1960. Services should start soon afterwards, as T.W.A.'s first aircraft was delivered, as scheduled earlier this month. The Convair 880 was fully described in *Flight*, July 25, 1958. Other references: February 27, 1959; August 8, 1958; October 10, 1958; January 31, 1958. Basic price of the domestic CV-880 Model 22 is £1.29m. and the overwater Model 31, £1.41m.

Model 22 (Domestic)

Powerplant: Two General Electric CJ-805-3 turbojets "in the 11,000 lb thrust class."

Dimensions: Span, 120ft; length, 129ft 4in; height, 36ft 3in; wing area, 2,000 sq ft.

Weights: Max. take-off, 184,500 lb; landing, 132,800 lb; zero fuel, 132,800 lb; capacity payload, 27,600 lb; weight less fuel and payload, 89,000 lb.

Payload accommodation: Cabin volume (less flight deck), 4,750 cu ft; baggage and freight volume, 863 cu ft; cabin length, 89ft 3in; max. width, 10ft 8in; max. height, 7ft 10in; dimensions of largest door, 74in × 30in; max. seats, 124.

Fuel capacity: 10,770 U.S. gal (8,970 Imp. gal).

Performance: Cont. cruising speed, M = 0.84 at 35,000ft and 150,000 lb; fuel consumption in this condition, 0.0462 st.m./lb; balanced field length at max. take-off weight (SR311 continuous) at S.L., I.S.A., 7,750ft; at 5,000ft, I.S.A., 11,400ft; landing distance from 50ft at 120,000lb, 5,280ft; range A (max. payload) 3,490 n.m. (4,000 st.m.); range B (max. fuel) 3,780 n.m. (4,350 st.m.); corres. payload 22,950 lb; corres. speed 434 kt (500 m.p.h.).

Model 31 (International) As Model 22 except:

Weights: Max. take-off, 203,400 lb; landing, 155,000 lb; zero fuel, 124,000 lb; capacity payload, 33,600 lb; weight less fuel and payload, 92,400 lb.

Fuel capacity: 13,870 U.S. gal (11,550 Imp. gal).

Performance: Cont. cruising speed M = 0.84 at 35,000ft and 160,000 lb; fuel consumption under this condition, 0.044 st.m./lb; balanced field length at max. take-off weight (SR422 continuous), S.L., I.S.A., 8,900ft; at 5,000ft, I.S.A., 13,700ft; landing distance from 50ft (at 124,000 lb), 4,800ft; range A (max. payload), 3,710 n.m. (4,260 st.m.); range B (max. fuel), 5,130 n.m. (5,900 st.m.); corres. payload, 18,670 lb; corres. cruise speed, 436 kt (502 m.p.h.).

Convair 880M In October Convair announced that Capital Airlines had placed an order for seven Convair 880Ms. This is a modified version (M stands for modified) of the Convair 880 Model 22, tailored for shorter ranges and to reduce turn-around time on the ground. Modifications include the addition of leading edge slats, a larger fin with power-boosted rudder, and provision for pre-loaded baggage and cargo bins. The -3B G.E. turbojets are said to deliver "4 per cent more thrust for 2 per cent less fuel"; they will be equipped with sound suppressors and thrust reverse. The price to be paid by Capital is £1.27m each.

Powerplant: Four General Electric CJ-805-3B turbojets.

Dimensions: As Model 22.

Weights: Max. take-off, 191,000 lb; landing, 155,000 lb.

Convair 600 Largest, heaviest and fastest of the family, the 600 was designed to carry up to 139 passengers, to have U.S. transcontinental range and to fly faster than any other commercial transport. Fuselage length was increased by 10ft, max. weight raised to 239,000 lb, and the aircraft area-ruled by the addition of substantial anti-shock bodies extending beyond the trailing edge of the wing (parts of these provide useful fuel storage). The claimed maximum cruising speed is Mach 0.91 (up to 635 m.p.h.). Designation is **Model 30.**

American Airlines placed the first order for CV-600s, for 25 (with an additional 25 on option) to be delivered from June 1961. In general it is the CV-600 that is offered for sale overseas. The S.A.S./Swissair consortium has ordered seven, giving the 600 the class name **Coronado.** The first flight should take place in August 1960, and 8½ months will be devoted to flight tests. Price, fully equipped, is about £1.57m. *Flight* cutaway drawing, pages 590-591.

Powerplant: Four General Electric CJ-805-21 aft-fan turbojet "in the 16,000 lb thrust class."

Dimensions: Span, 120ft; length 139ft 5.5in; height, 39ft 6.1in; wing area, 2,250 sq ft.

Weights: Max. take-off, 234,200 lb; landing, 180,000 lb; zero fuel, 149,000 lb; capacity payload, 34,000 lb; weight less fuel and payload, 115,000 lb.

Payload accommodation: Cabin volume (less flight deck), 5,120 cu ft; baggage and freight volume, 928 cu ft; cabin length, 89ft 9in; max. width, 10ft 8in; max. height, 7ft 10in; max. usable floor area (less flight deck), 900 sq ft; dimensions of largest door, 74in × 30in; max. seats, 139.

Fuel capacity: 15,108 U.S. gal (can be increased by about 564 U.S. gal with special fuel management programme).

Performance: Cont. cruising speed M = 0.86 at 35,000ft and 190,000 lb; corres. fuel consumption, 0.0447 st.m./lb; balanced field length at max. take-off weight (SR477 continuous), S.L., I.S.A., 7,800ft; at 5,000ft, I.S.A., 12,000ft; landing distance from 50ft (150,000 lb), 4,650ft; range A (max. payload), 4,200 n.m. (4,830 st.m.); range B (max. fuel), 5,410 n.m. (6,220 st.m.); corres. payload, 23,800 lb; corres. speed, 456 kt (537 m.p.h.).

Convair Supersonic Airliner All the major U.S. air transport manufacturers have plans for a supersonic transport and Convair has released various drawings of the shapes that might be adopted. These visualize an aircraft climbing subsonically to 35,000ft before accelerating to a cruising speed of Mach 3 or more at 60-70,000ft. It would have a range of 3,000 n.m. Apart from supersonic experience with the B-58 Hustler, Convair claim to have studied more than 100,000 possible configurations and accumulated more than 10,000 wind tunnel hours on the most promising variants. In order to climb and descend quickly, maximum cabin altitude would be limited to 3,000ft and a water-jacketed double-shell fuselage with an aluminium alloy inner skin has been considered. Flying controls would be fully powered. As to size, Convair are thinking in terms of carrying 135 passengers in an aeroplane that will be fitted in an envelope "30 to 50ft high, 70 to 120ft wide, and 170 to 230ft long." They also claim a 12 per cent improvement in direct operating costs for a Mach 3 aircraft over the CV-880 and say they could deliver in 1965 a Mach 2 aircraft that would "make money."

CURTISS

CW-20/C-46 The pressurized Curtiss CW-20 prototype first flew on March 26, 1940. It was later redesigned to have a single fin and rudder, and was taken over by the U.S.A.A.F. under the designation C-55-CS. It was acquired by B.O.A.C. in 1941. Production for the airlines was forestalled by Pearl Harbor, but a total of 3,181 unpressurized military transport versions were built for the U.S.A.A.F. as the C-46 **Commando,** powered by Pratt & Whitney R-2800 Double Wasps. A post-war commercial version, the CW-20E, was planned but abandoned after Eastern Air Lines cancelled an order. But after 1945 many war-surplus C-46s were acquired by commercial operators, especially in North and Latin America, where 356 Commandos are now used by 91 carriers, although only 35 are used outside the Americas (by ten airlines).

The CW-20T version (*Flight*, May 4, 1956), evolved by Air Carrier Engineering Services and the L.B. Smith Aircraft Corp. of Miami, was awarded an unrestricted C.A.A. certificate in 1956, as the result of some 30 engine and airframe improvements. In March 1958 L. B. Smith obtained approval at 50,100 lb max. weight for another modified version known as the Super 46C; in November 1958 this weight was increased to 50,650 lb. Riddle Airlines, Inc., largest commercial operator of C-46s, produced a broadly similar conversion, the **C-46R,** which was awarded a transport-category certificate in March 1957 (*Flight*, November 28, 1958). Current second-hand market prices being asked range from about £30,000 for C-46F conversions to £67,200 for the C-46R.

C-46A, C-46D, C-46F

Powerplant: Two Pratt & Whitney R-2800-51MI Double Wasps of 2,000 b.h.p. each driving Hamilton Standard 14ft 6in propellers.

Dimensions: Span, 108ft; length, 76ft 4in; height, 21ft 9in; wing area, 1,358 sq ft.

Weights: Max. take-off, 48,000 lb; landing, 48,000 lb; zero fuel, 47,130 lb; capacity payload, 17,600 lb; empty, 29,100 lb.

Payload accommodation: Cabin volume, 2,300 cu ft; under-floor freight hold volume, 432 cu ft; cabin length, 48ft; max. width, 9ft; max. height, 6ft 8in; usable floor area 348 sq ft; largest door, 95½in × 78½in.

Fuel capacity: 1,406 U.S. gal (1,170 Imp. gal).

Performance: Cruising speed, 169 kt (195 m.p.h.) at 9,000ft at 48,000 lb and 950 b.h.p. per engine; corresponding fuel consumption, 150 gal/hr; balanced field length, 4,575ft at sea level, I.S.A.; landing distance from 50ft, 2,240ft; max. range, 1,560 n.m. (1,800 st.m.) at 169 kt (195 m.p.h.) with 9,584 lb payload.

DE HAVILLAND *The de Havilland Aircraft Co. Ltd., Hatfield, Herts.*

D.H. 89 Dragon Rapide Known as the Dragon Six when it first flew in April 1934, the Rapide was designed to provide air transport that would pay its way on a very limited flow of traffic. A total of 697 Rapides were built, of which 102 are still in service with 42 airlines. Last development was the Rapide 6, with Fairey X5 propellers giving an increased take-off weight of 6,000 lb and an improved payload.

Powerplant: Two de Havilland Gipsy Queen 3 of 205 b.h.p. each.

Dimensions: Span, 48ft; length, 34ft 6in; height, 10ft 3in; wing area, 340 sq ft.

Weights: Max. take-off, 5,550 lb; empty, 3,230 lb.

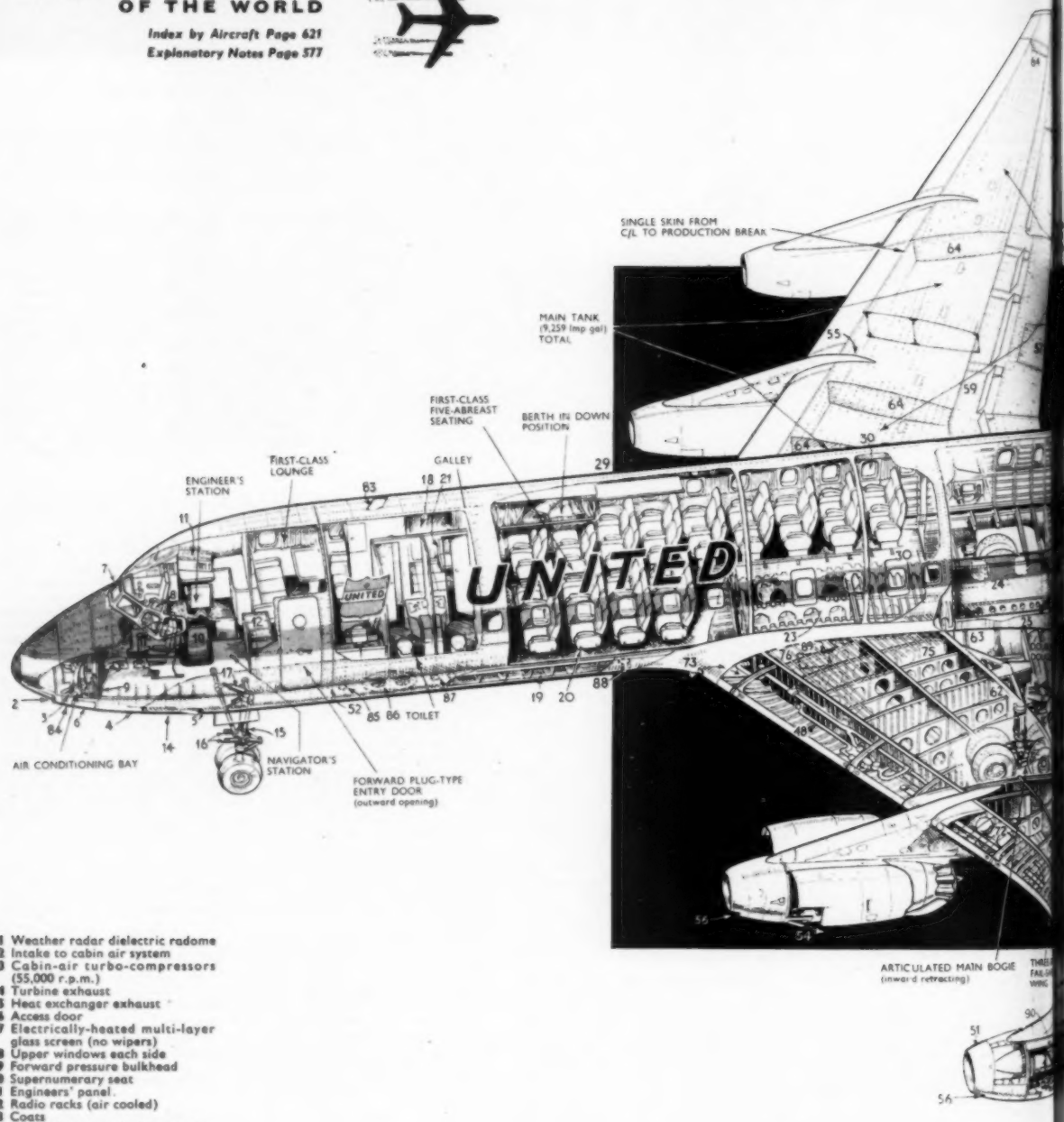
Performance: A payload of 800 lb can be carried for 185 n.m. (213 st.m.) cruising at 101 kt (117 m.p.h.) at 2,000ft.

D.H.104 Dove 5 and 6 First flown on September 25, 1945, the Dove was marketed as an "airliner in miniature." Over 500 have been built—more than any other British airliner—and 55 are currently in service with 27 airlines. New price is about £35,000 less radio.

(*Continued on page 596, after double-page drawing*)

COMMERCIAL AIRCRAFT OF THE WORLD

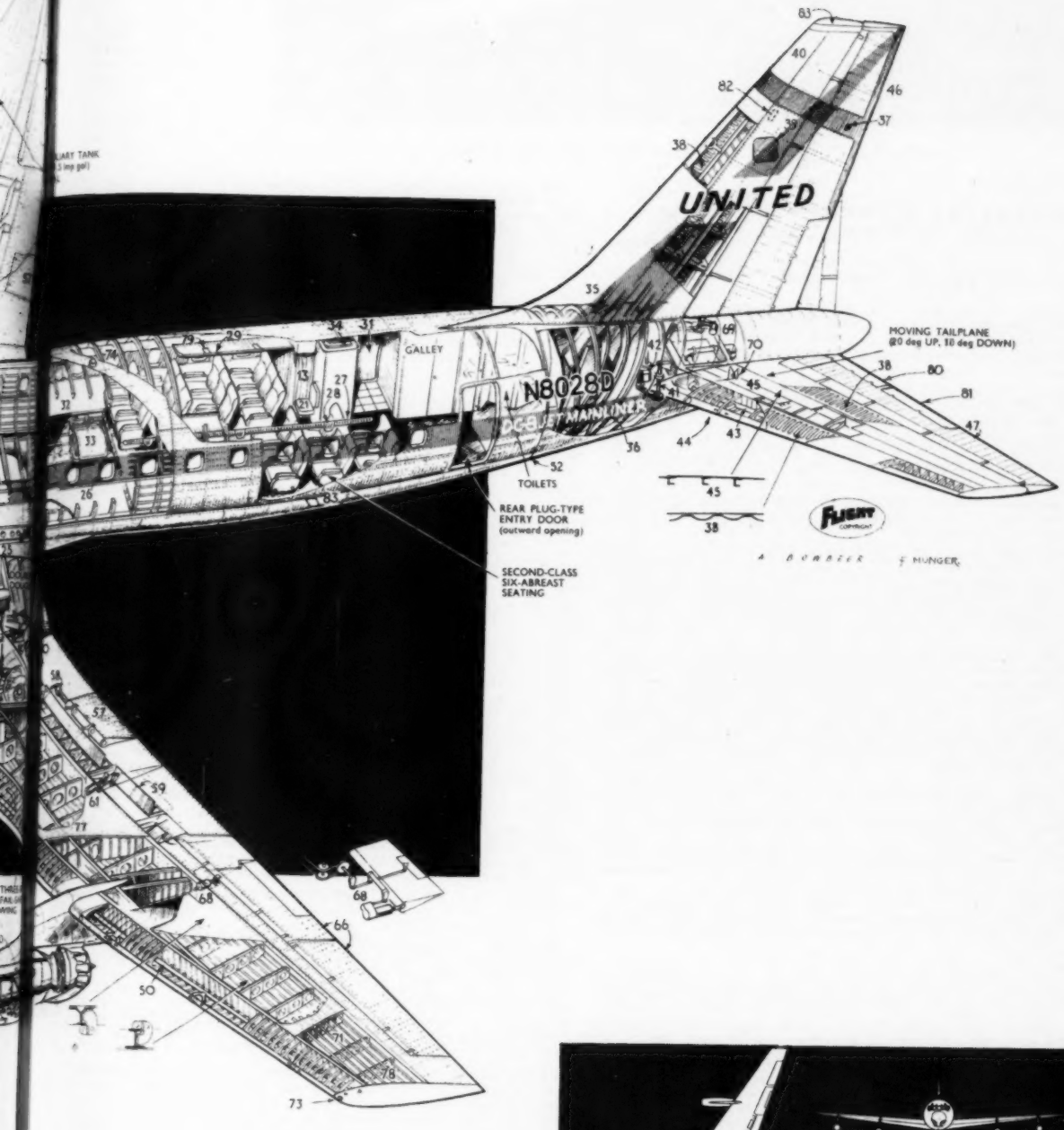
Index by Aircraft Page 621
Explanatory Notes Page 577

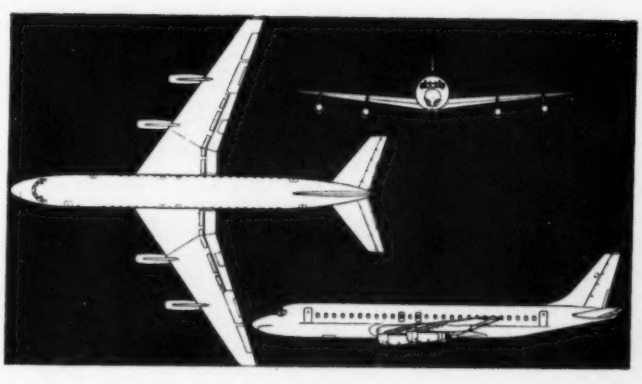


1 Weather radar dielectric radome
2 Intake to cabin air system
3 Cabin-air turbo-compressors (55,000 r.p.m.)
4 Turbine exhaust
5 Heat exchanger exhaust
6 Access door
7 Electrically-heated multi-layer glass screen (no wipers)
8 Upper windows each side
9 Forward pressure bulkhead
10 Supernumerary seat
11 Engineers' panel
12 Radio racks (air cooled)
13 Coats
14 Pre-closing nosewheel-bay doors
15 DC-7 type nose gear geometry
16 Steering cylinders (10 deg each way with rudder, 78 deg by hand-wheel)
17 Retraction jack
18 Galley service door
19 Underfloor hold (door starboard)
20 Wall-fixed slots
21 Attendant's seat
22 Centre-joint butt-strap
23 Centre section tank ("overwater" model only)
24 Centre keel-member (5ft deep)
25 Mainwheel doors (normally closed after undercarriage extension)
26 Windows (18½ × 15in)
27 Cabin air in: out at floor level
28 Passenger-address speaker
29 Hat racks
30 Emergency exits
31 Emergency doors
32 "Hot wall" panelling
33 Inward-opening freight door
34 Concealed lighting
35 Integral three-spar fin
36 Sloping frames
37 Fibreglass (dielectric) structural isolation
38 Bonded inner skin
39 V.O.R. aerial
40 H.F. aerials (1 and 2)
41 Tailplane screw-jacks
42 Tailplane hydraulic and electric motors
43 Tail de-icing trunk
44 Retractable bumper
45 Integrally-stiffened skin
46 Fully-powered rudder
47 Manual elevators
48 Fuel system runs
49 De-icing duct (cyclic heat)
50 De-icing trunk
51 Hot air anti-icing
52 Production break
53 Pratt & Whitney JT3
54 Oil cooler outlet
55 Inswept pylon tails
56 Intake to Sundstrand-drive oil-coolers
57 Portion of flap held up to clear jet-blast
58 Linkage to 57
59 Lift spoilers (operated by nose-wheel to ground contact)
60 Multiple scissor-links (inner to outer flap)
61 Flap-operating linkage
62 Main-leg subframe
63 Main-leg retraction jack
64 Tank bay end-ribs (full depth)
65 Unnotched ribs (not full depth)
66 Divided, powered, ailerons (inner = high speed, outer = low speed)
67 Bonded trailing-edge structure
68 Aileron power unit (emergency manual tab)
69 Rudder power-unit
70 Tailplane hinge axis
71 Tank for injection water (JT3 engine only)
72 Fire-suppression bottles (378 cu in C.B. and Freon)
73 Leading-edge venting
74 Air brakes
75 Skin thickness 0.250in
76 Skin thickness 0.190in
77 Skin thickness 0.156in
78 Upper skin 0.064in, lower 0.063in
79 Passenger service panels (position variable with seat pitch)
80 Control tab
81 Geared tab
82 H.F. antenna coupler and lightning arrester
83 V.H.F. aerials (three)
84 Glide-slope aerial
85 D.M.E. aerial
86 A.D.F. aerials
87 Transponder
88 Radio altimeter aerial
89 A.D.F. sense aerials (four)
90 Oil tank
91 Noise suppressors

DOUGLAS DC-8

Reference: page 607





de Havilland Comet 4B of B.E.A. (Rolls-Royce Avon 525B turbojets)

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

Powerplant: Two D.H. Gipsy Queen 70 Mk 2s of 380 b.h.p. each driving de Havilland Hydromatic 3/1000/3 7ft 5in propellers.

Dimensions: Span, 57ft; length, 39ft 3in; height, 13ft 4in; wing area, 335 sq ft.

Weights: Max. take-off, 8,800 lb; landing, 8,500 lb; zero fuel, 8,338 lb; capacity payload, 2,130 lb; weight less fuel and payload, 6,208 lb (including 2 crew).

Payload accommodation: Baggage and freight volume, 67 cu ft; cabin length, 14ft 6in; max. width, 4ft 8in; max. height, 5ft 4in; usable floor area, 72.5 sq ft; dimensions of largest door, 50in × 29in; max. seats, 11.

Fuel capacity: 168 Imp. gal (202 U.S. gal).

Performance: Cruising speed, 155 kt (179 m.p.h) at 8,000ft and 8,500 lb; range B (max. fuel), 868 n.m. (1,000 st.m.) at 156 kt (179 m.p.h.) with 1,300 lb payload.

D.H.106 Comet 4 The Comet 4 stems from the Comet 1 which B.O.A.C. operated from 1952-1954. The Comet 4 is a revised version of the long-fuselage Mark 3, with more power, range and payload and incorporating the structural knowledge gained in the accidents of 1954. The first of 19 Comet 4s for B.O.A.C. made its initial flight on April 27, 1958, and B.O.A.C. inaugurated the first transatlantic jet services with these aircraft on October 4, 1958, following with Comet services to India, Hong Kong and Japan, and on November 1 last to Australia. Aerolineas Argentinas operates Comet 4s from Buenos Aires to Santiago de Chile, New York and Europe. Two more Comet 4s are on order for East African Airways Corporation. Previously certified at 158,000 lb, the Comet 4 and 4C can now be operated at 162,000 lb without increasing tare weight, thus giving a longer range with capacity payload or an improved payload over stages where the latter is limited by fuel.

Basic price: £1.14m. *Flight* references: March 28, 1958; July 25, 1958, October 24, 1958.

Powerplant: Four Rolls-Royce Avon 524 RA.29/1 turbojets of 10,500 lb thrust each.

Dimensions: Span, 115ft; length, 111ft 6in; height, 29ft 6in; wing area, 2,121 sq ft.

Weights: Max. take-off, 162,000 lb; landing 120,000 lb; zero fuel, 99,000 lb; capacity payload (60-seat, first-class), 16,800 lb; weight less fuel and payload (60-seat, first-class), 75,200 lb.

Payload accommodation: Cabin volume, 2,815 cu ft; baggage and freight volume, 570 cu ft; cabin length, 71ft 8in; max. width, 9ft 7in; max. height, 6ft 6½in; usable floor area, 439 sq ft; entrance door dimensions, 56in × 30in; max. seats, 81.

Fuel capacity: 8,900 Imp. gal.

Performance: Cont. cruise speed, 438 kt (505 m.p.h.) at 28,000ft and 130,000 lb with fuel consumption of 9,650 lb/hr; balanced field length, max. take-off weight, sea level, I.S.A., 6,750ft; landing field length, max. landing weight, sea level, I.S.A., 6,630ft; range A (max. payload), 3,760 n.m. (4,330 st.m.) (60-seat first class); range B (max. fuel), 3,790 n.m. (4,360 st.m.) at 405 kt (465 m.p.h.) with 12,300 lb.

D.H.106 Comet 4B The Comet 4B was evolved to B.E.A.'s requirements for a "first-generation" jet. Seven are being delivered to B.E.A. and two are on order for Olympic Airways. Main difference compared with the Comet 4 is a 6ft 6in longer fuselage, seating up to 102 passengers. To allow higher cruising speeds at lower altitudes, wing span is reduced by 7ft 2in, and the Comet 4B's medium-range rôle enables the pod-type wing tanks to be deleted. B.E.A.'s contract for six aircraft was valued at "about £7m" with spares.

Powerplant: Four Rolls-Royce Avon 525B RA.29/1 turbojets of 10,500 lb static thrust each.

Dimensions: Span, 107ft 10in; length, 118ft; height, 29ft 6in; wing area, 2,059 sq ft.

Weights: Max. take-off, 158,000 lb; landing, 120,000 lb; zero fuel, 102,500 lb; capacity payload (72-seat, first-class), 19,600 lb; weight less fuel and payload (72-seat, first-class), 77,000 lb.

Payload accommodation: Cabin volume, 3,160 cu ft; baggage and freight volume, 640 cu ft; cabin length, 78ft 2in; max. width, 9ft 7in; max. height, 6ft 6½in; usable floor area, 529 sq ft; entrance door dimensions, 56in × 30in; max. seats, 102.

Fuel capacity: 7,800 Imp. gal.

Performance: Cont. cruising speed, 452 kt (520 m.p.h.) at 23,500ft and 135,000 lb, with fuel consumption of 11,500 lb/hr; balanced field length, max. take-off weight, sea level, I.S.A., 6,600ft; sea level, I.S.A. +15 deg C, 7,450ft; at 5,000ft, I.S.A., 9,300ft; landing field length, max. landing weight, sea level, I.S.A., 6,660ft; range A (max. payload), 3,150 n.m. (3,630 st.m.) (72-seat, first-class), range B (max. fuel), 3,170 n.m. (3,650 st.m.) at 405 kt (465 m.p.h.) with 19,300 lb payload (72-seat, first-class).

D.H.106 Comet 4C The Comet 4C is the intermediate-range version of the Comet family. It combines the 4B's longer fuselage with the Comet 4's wing and fuel tankage; this enables it to carry more payload than the Mark 4 at a slight sacrifice in maximum range. An order for three was placed on October 30 by Mexicana, worth £5m with spares and equipment.

Powerplant: Four Rolls-Royce Avon 524 RA.29/1 turbojets of 10,500 lb static thrust each.

Dimensions: As Comet 4, except length, 118ft.

Weights: As Comet 4B, except weight less fuel and payload (72-seat, first-class), 77,500 lb.

Payload accommodation: As Comet 4B.

Fuel capacity: As Comet 4.

Performance: Cont. cruising speed, 435 kt (500 m.p.h.) at 33,000ft and 135,000 lb with fuel consumption of 8,800 lb/hr; balanced field length, max. take-off weight, sea level, I.S.A., 6,350ft; sea level, I.S.A. +15 deg C, 7,100ft; 5,000ft, I.S.A., 8,750ft; landing field length, max. landing weight, sea level, I.S.A., 6,570ft; range A (max. payload), 3,360 n.m. (3,860 st.m.) (72-seat, first-class); range B (max. fuel), 3,780 n.m. (4,350 st.m.) at 405 kt (465 m.p.h.) with 13,800 lb payload (72-seat, first-class).

D.H. 114 Heron 1 and 2 Essentially a scaled-up, four-engined version of the Dove, the Heron was designed to bring "mainliner" standards to feeder-line routes. The Heron 1 prototype first flew on May 10, 1950. Initial production was of the Mk 1, which featured a fixed nosewheel undercarriage and non-feathering propellers. This version was superseded in production by the Heron 2, which has a retractable undercarriage and feathering propellers. A total of 136 Herons have been built, of which over 80 are in airline service. More are used by air forces, executive owners and by the Queen's Flight. Price new is about £60,000 less radio. Particulars below refer to the Heron 2.

Powerplant: Four D.H. Gipsy Queen 30 Mk 2s of 250 b.h.p. each driving de Havilland Hydromatic 2/1000/2 7ft propellers.

Dimensions: Span, 71ft 6in; length, 48ft 6in; height, 15ft 7in; wing area, 499 sq ft.

Weights: Max. take-off, 13,500 lb; landing, 13,150 lb; zero fuel, 12,670 lb; capacity payload, 3,750 lb; weight less fuel and payload, 8,996 lb (including 2 crew).

Payload accommodation: Cabin volume, 515 cu ft; baggage and freight volume, 127 cu ft; cabin length, 23ft; max. width, 4ft 6in; max. height, 5ft 9in; usable floor area, 89 sq ft; dimensions of largest door, 51in × 33.5in; max. seats, 17.

Fuel capacity: 412 Imp. gal (495 U.S. gal).

Performance: Cruising speed, 159 kt (183 m.p.h.) at 8,000ft and 13,000 lb; balanced field length, 3,570ft; range B, 1,538 n.m. (1,771 st.m.) at 158 kt (183 m.p.h.) with 1,320 lb payload.

D.H.121 B.E.A. issued a general specification for a "second-generation" jet airliner to the British aircraft industry in July 1956. Not until February 1958, after a long drawn-out political controversy, were B.E.A. allowed to place a provisional order for the D.H.121 Though de Havilland were prepared to finance the aircraft alone, in accordance with Government policy the Airco consortium was formed with Fairey and Hunting (see Airco, p. 578) to design, manufacture and develop the D.H.121.

The original D.H.121 (*Flight*, July 25, 1958, p. 120) was an 111-seater (max.) with a take-off weight of 123,000 lb. Powerplant was three Rolls-Royce RB.141s of 12,000 lb static thrust. During the early months of 1959, as RB.141 power increased, it became apparent that the 121 had grown too large for B.E.A.'s requirements. The design was revised around three Rolls-Royce RB.163s of 10,100 lb static thrust each, with a max. weight of 105,000 lb and seating reduced to a maximum of 100. The dimensions were scaled down (with the exception of fuselage diameter) all round. Fullest details published to date appeared in *Flight* of August 21 and September 4, 1959.

The engines are rear-mounted, and the unique triple-turbojet formula is claimed to satisfy most efficiently the thrust requirements of take-off

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

and cruise. "With four engines the aircraft would be overpowered on take-off, and with two would be overpowered in the cruise." The broad strategy of the 121 might be summed up as a 600 m.p.h. jet with a 6,000ft take-off and "optimized" economics for the shorter trunk-route stages of up to 1,000 miles.

A firm contract for 24 aircraft, for delivery to B.E.A. towards the end of 1963, was signed on August 12, 1959. All 24 aircraft should be delivered by September 1965. First flight of the 121 should take place in 1961. Value of the B.E.A. contract is £28m with spares.

Flight references: August 21, 1959, p. 57; August 28, 1959, p. 91; September 4, 1959, p. 102.

Powerplant: Three Rolls-Royce RB.163 by-pass turbojets of 10,100 lb static thrust each.

Dimensions: Span, 89ft 10in; length, 114ft 8in; height, 27ft 6in; wing area, 1,358 sq ft; sweepback, 35 deg.

Weights: Max. take-off, 105,000 lb; landing, 100,000 lb; zero fuel, 85,500 lb; capacity payload, 22,000 lb; weight less fuel and payload, 63,200 lb.

Payload accommodation: Cabin volume, 4,412 cu ft; baggage and freight volume, 620 cu ft; cabin length, 66ft 10½in (port side), 65ft 8in (starboard side); max. width, 11ft 4½in; max. height, 6ft 8in; max. usable floor area, 708 sq ft; largest door, 62½in × 28in; max. seats, 100.

Fuel capacity: 3,840 Imp. gal.

Performance: Cont. cruise speed, 528 kt (606 m.p.h.) at 25,000ft and 100,000 lb; balanced field length, max. take-off weight, sea level, I.S.A., 6,000ft; sea level, I.S.A. +15 deg C, 6,700ft; landing aerodrome length, 6,260ft; range A (max. payload), 1,495 n.m. (1,720 st.m.); range B (max. fuel), 2,350 n.m. (2,710 st.m.).

D.H.123 No official details of this "DC-3 replacement" project have been released. One design study is based on two de Havilland Gnome turboprops of 1,250 s.h.p. mounted on a high wing. Seating is reportedly for up to 36 passengers.

A.S.57 Ambassador Designed to the Brabazon Committee Type IIA specification as an inter-city airliner, the Airspeed A.S.57 Ambassador first flew on July 10, 1947 and entered service in 1952 with B.E.A., who named it Elizabethan. Until 1957, B.E.A. was the only operator, but in that year three were sold to Butler Air Transport of Australia. Only 21 of these high-wing monoplanes were built, and today B.K.S. Air Transport Ltd., with three ex-B.E.A. aircraft, is the only operator. Most of the remaining B.E.A. and Butler Elizabethans are at present in store awaiting sale at a price of £69,500 each with zero-time engines and airframes.

Powerplant: Two Bristol Centaurus 661s of 2,625 b.h.p. driving D.H. Hydromatic 4-blade 16ft propellers.

Dimensions: Span, 115ft; length, 82ft; height, 18ft 3in; wing area (gross), 1,200 sq ft; aspect ratio, 11.

Weights: Max. take-off, 55,000 lb; max. landing, 52,000 lb; zero fuel, 52,000 lb; capacity payload, 11,645 lb; tare weight, 36,650 lb.

Payload accommodation: Cabin volume, 2,168 cu ft; baggage and freight volume, 333 cu ft; cabin length, 32ft 5in; max. width, 10ft 6in; min. height, 6ft. 4½in; max. seats, 55.

Fuel capacity: 1,000 Imp. gal (1,200 U.S. gal).

Performance: Cruising speed 250 kt (288 m.p.h.) at 19,000ft at 50,000 lb; take-off to 50ft, 3,420ft at 52,500 lb; landing distance from 50ft, 2,901ft; a typical payload-range performance, 9,950 lb over 408 n.m. (470 st.m.) at 220 kt (253 m.p.h.) at 15,000 ft.

DE HAVILLAND AIRCRAFT PTY. *P.O. Box 30, Bankstown, N.S.W., Australia.*

DHA.3 Drover First flown on January 23, 1948, the Drover was designed to Australian requirements as a post-war successor to the DH.84 Dragon, with emphasis on simplicity (e.g. fixed undercarriage), ruggedness and a good performance with one engine inoperative. Only 20 Drovers were built, of which eight are in service with Fiji Airways, Qantas and T.A.A. The latter's Drovers are among six operated by the Royal Flying Doctor Service which are being re-engined at Bankstown with more powerful Lycoming O-360-A1A engines driving Hartzell propellers, in place of the three Gipsy Major Mk 10s.

THE DE HAVILLAND AIRCRAFT OF CANADA *Downsview, Toronto, Ontario, Canada.*

DHC.2 Beaver The Beaver first flew on August 19, 1947. It has been found suitable for outback operation all over the world, and more than 1,300 Beavers have been delivered and are in use in some 60 countries; 918 of these are L-20As of the U.S.A.F. and U.S. Army. Commercial Beavers have been used not only for passenger carrying, but for countless other duties. The one and only Beaver 2 is fitted with a 550 b.h.p. Alvis Leonides 502/4; standard powerplant is the 450 h.p. Wasp Junior.

DHC.3 Otter Developed, like the Beaver, for Canadian conditions, the Otter first flew on December 12, 1951 and, like the Beaver, is offered in landplane, seaplane, amphibian, skiplane or wheel-skiplane versions. The Otter is also used by airlines in Norway, Vietnam, Laos, Japan, the Philippines and New Guinea, while military Otters equip the air forces of Canada, Norway, Colombia and India, as well as the U.S. Army (U-1A utility versions) and U.S. Navy (UC-1 utility versions). Over 300 Otters have been built so far, of which more than 200 are U-1As. Powerplant is the 600 h.p. P. & W. R-1340 Wasp.

DHC.4 Caribou The Caribou had its origin in design studies for a "Twin Otter" grossing 13,000 lb, with two Otter-type powerplants and a fixed undercarriage. The Caribou's ultimate configuration was determined by U.S. and Canadian Army desires for rear loading, and the need for good STOL characteristics and climb after take-off, together with a reasonable single-engined ceiling. The first of three prototypes made its maiden flight on July 30, 1958, and the first of five YAC-1A Caribous for the U.S. Army was delivered on October 8, 1959. Production aircraft feature a 3ft 9in longer fuselage.

Powerplant: Two Pratt & Whitney R-2000-7M2 Twin Wasps of 1,450 b.h.p. each driving 13ft 1in Hamilton Standard propellers.

Dimensions: Span, 96ft; length, 72ft 7in; height, 31ft 9in; wing area, 912 sq ft; aspect ratio, 9.9.

Weights: Max. take-off, 26,000 lb; landing, 26,000 lb; zero fuel, 16,272 lb; capacity payload, 7,525 lb.

Payload accommodation: Cabin volume, 1,150 cu ft; cabin length, 32ft 6in; max. width, 7ft 3in; max. height, 6ft 3in; dimensions of rear entrance, 73.5in × 75in; max. seats, 40.

Fuel capacity: 700 Imp. gal (840 U.S. gal).

Performance: Cruising speed, 157 kt (180 m.p.h.) at 7,500ft and 26,000 lb; balanced field length at max. take-off weight, sea level, I.S.A., 2,340ft; landing distance from 50ft, 1,020ft; range with max payload, still air, I.S.A., 695 n.m. (800 st.m.), max. range, optimum cruise, still air, I.S.A., 1,260 n.m. (1,450 st.m.) at 157 kt (180 m.p.h.) at 7,500ft with 5,265 lb payload.

DOUGLAS *The Douglas Aircraft Company, Santa Monica, California, U.S.A.*

DC-3 The most famous and widely-used airliner ever built, the DC-3 occupies a unique position in air transport. It is a twin-engined unpressurized aeroplane capable of carrying 20-30 passengers on stages of up to about 1,000 miles at a cruising speed of about 170 m.p.h. It set entirely new standards in airliner design and operation which were universally accepted and copied.

The DC-3 is a development of the DC-1 and DC-2 (designed for T.W.A.) which, with the Boeing 247 (designed for United), were the first airliners of the modern stressed-skin all-metal cantilever low-wing monoplane formula. It made its first flight on December 22, 1935, having itself originally been designed to meet an American Airlines requirement for a sleeper version of the DC-2 suitable for use on the longer trunk U.S. domestic routes. However, it was the "Day Plane" model of the "Douglas Sleeper Transport" which became the DC-3. All told, a total of 10,928 DC-3s and military C-47s were built in the United States, in addition to about 2,000 under licence in Russia and 450 in Japan. Some 1,672 are still in service with 235 airlines—nearly as many as all other types of airliner taken together. The DC-3 in 1936 cost £18-23,000 and resale prices today are around £25,000.

Powerplant: Two Pratt & Whitney R-1830-92s of 1,200 b.h.p. driving three-bladed Hamilton Standard Hydromatic 11ft 6in propellers.

Dimensions: Span, 95ft; length, 64ft ⅓in; height, 16ft 11½in; wing area, 987 sq ft.

Weights: Max. take-off, 25,200 lb (U.S. passenger), 26,900 lb (U.S. freight), 28,000 lb (U.K.); landing, 24,400 lb (U.S. passenger), 26,900 lb (U.K. and U.S. freight); no zero fuel restriction; capacity payload, 5,380 lb; weight less fuel and payload, 17,720 lb.

Payload accommodation: Cabin volume, 1,245 cu ft; baggage and freight volume, 160 cu ft; cabin length, 30ft ⅓in; max. width, 7ft 8in; max. height, 6ft 7in; max. usable floor area, 191 sq ft; dimensions of largest door, 5ft 10in × 7ft (C-47); max. seats, 28.

Fuel capacity: 670 Imp. gal (805 U.S. gal).

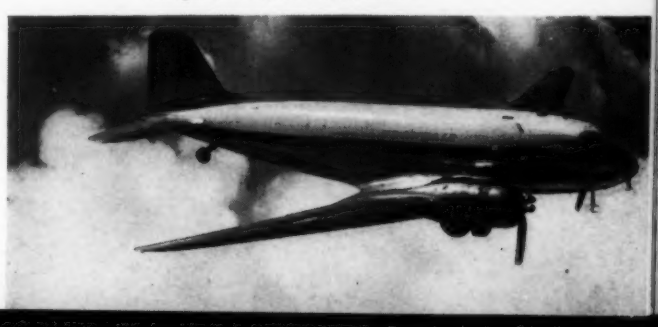
Performance: Cont. cruising speed, 155 kt (178 m.p.h.) at 10,000ft and 25,200 lb; corres. consumption 73.5 Imp. gal/hr; balanced field length, max. take-off weight, S.L., I.S.A., 4,050ft; at S.L., I.S.A.+15 deg C, 4,400ft; landing distance from 50ft, 1,980ft; range A (max. payload), 173 n.m. (199 st.m.); range B (max. fuel), 1,780 n.m. (2,505 st.m.); corres. payload, 8,600 lb; corres. cruise speed, 155 kt (178 m.p.h.).

DC-4 The DC-4 has been to long-haul air transport what its stablemate the DC-3 was to the growth of the short-haul sector of the business. It is a four-engined unpressurized aeroplane capable of carrying 40-86 passengers on stage lengths of up to about 2,500 miles at a cruising speed of about 200 m.p.h.

The origins of the DC-4 go back to a requirement for a larger medium-haul transport issued by the four largest American carriers (American, United, T.W.A. and Pan American) in mid-1935. Douglas produced a prototype—the DC-4E—to meet this requirement; this first flew on June 7, 1938, but did not prove satisfactory and was rejected by the airlines. Douglas thereupon started an entirely new and rather smaller project which became the DC-4. This flew for the first time on February 14, 1942. Orders for 61 were placed by American, Eastern and United early in 1940 but deliveries were diverted to military purposes and the type went into large-scale production and use as a military transport until the end of the War. Some 1,084 military DC-4s were delivered as C-54s before production was switched to a civil model at the end of the War, and 79 of this version were built before manufacture of the DC-4 was stopped in favour of the DC-6. The DC-4 cost between £140,000 and £160,000 in 1946/47. Price today is about £80,000.

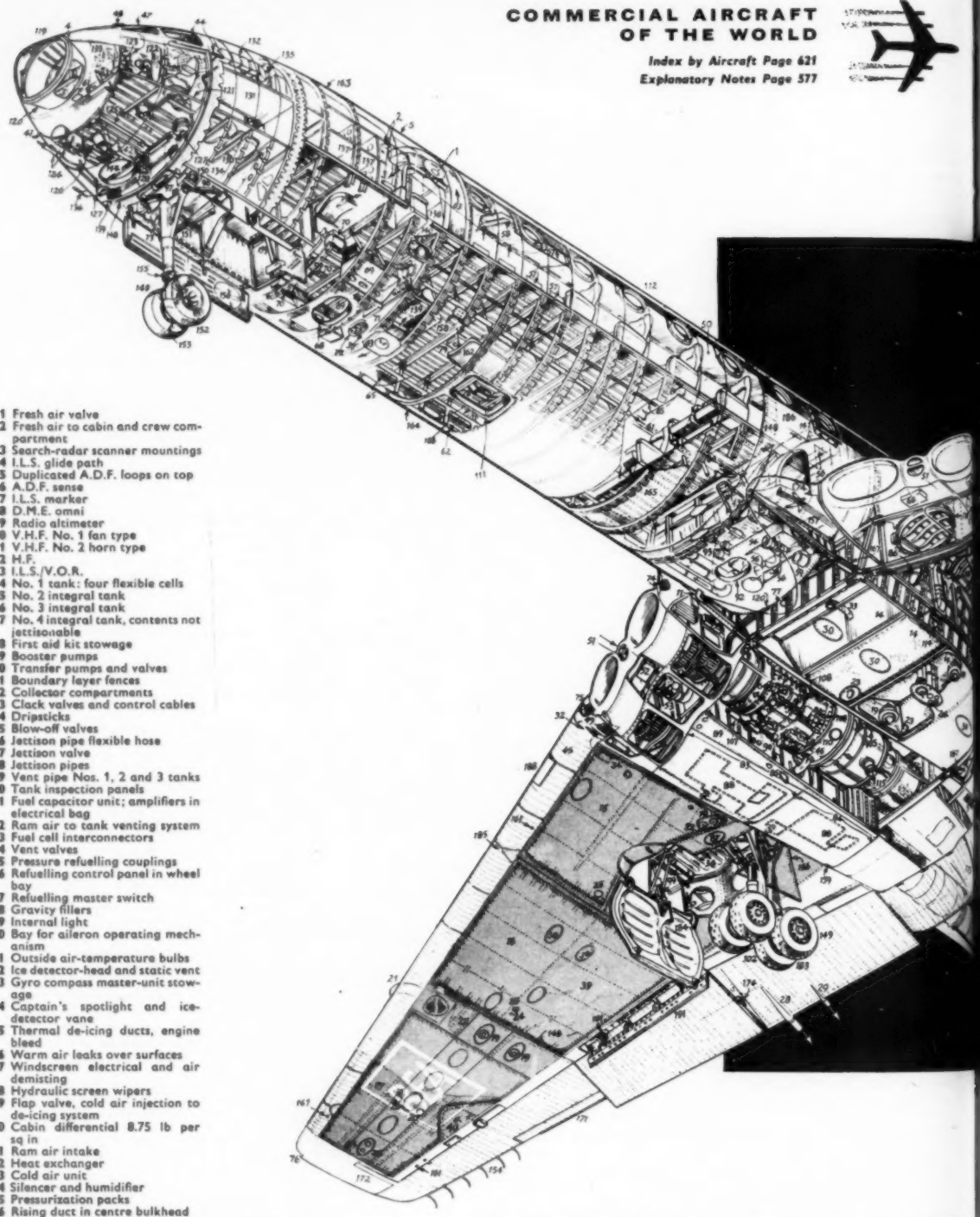
(Continued on page 606, after four double pages of drawings)

Douglas DC-3 (P. & W. R-1830s)



COMMERCIAL AIRCRAFT OF THE WORLD

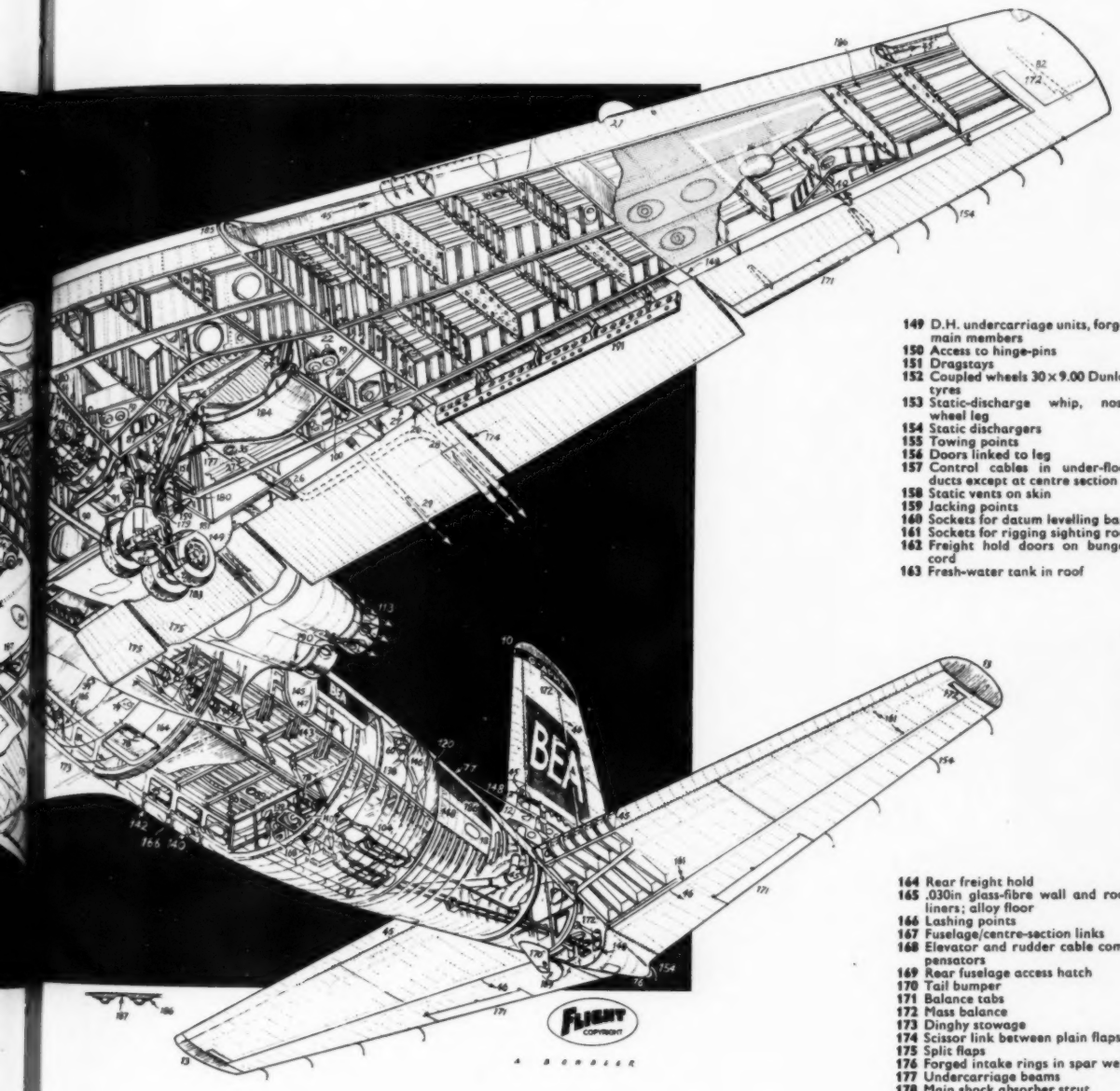
Index by Aircraft Page 621
Explanatory Notes Page 577



1 Fresh air valve
2 Fresh air to cabin and crew compartment
3 Search-radar scanner mountings
4 I.L.S. glide path
5 Duplicated A.D.F. loops on top
6 A.D.F. sense
7 I.L.S. marker
8 D.M.E. omni
9 Radio altimeter
10 V.H.F. No. 1 fan type
11 V.H.F. No. 2 horn type
12 H.F.
13 I.L.S./V.O.R.
14 No. 1 tank: four flexible cells
15 No. 2 integral tank
16 No. 3 integral tank
17 No. 4 integral tank, contents not jettisonable
18 First aid kit stowage
19 Booster pumps
20 Transfer pumps and valves
21 Boundary layer fences
22 Collector compartments
23 Clack valves and control cables
24 Dripsticks
25 Blow-off valves
26 Jettison pipe flexible hose
27 Jettison valve
28 Jettison pipes
29 Vent pipe Nos. 1, 2 and 3 tanks
30 Tank inspection panels
31 Fuel capacitor unit; amplifiers in electrical bag
32 Ram air to tank venting system
33 Fuel cell interconnectors
34 Vent valves
35 Pressure refuelling couplings
36 Refuelling control panel in wheel bay
37 Refuelling master switch
38 Gravity fillers
39 Internal light
40 Bay for aileron operating mechanism
41 Outside air-temperature bulbs
42 Ice detector-head and static vent
43 Gyro compass master-unit stowage
44 Captain's spotlight and ice-detector vane
45 Thermal de-icing ducts, engine bleed
46 Warm air leaks over surfaces
47 Windscreen electrical and air demisting
48 Hydraulic screen wipers
49 Flap valve, cold air injection to de-icing system
50 Cabin differential 8.75 lb per sq in
51 Ram air intake
52 Heat exchanger
53 Cold air unit
54 Silencer and humidifier
55 Pressurization packs
56 Rising duct in centre bulkhead
57 Air to floor level grilles
58 Recirculation-air venturi
59 Dump valves
60 Inward relief safety valves
61 Conditioned air to cockpit
62 Warm air to windscreen
63 Ground air connections and duct
64 Four 14 kVA generators
65 Two busbars
66 Rectifiers
67 Starter motor
68 Electrical service bay hatch
69 Six 24 V 25 amp/hr batteries
70 Main inverters (two) and standby
71 Main distribution panels
72 Ground supply sockets: two 28 V, one 112 V
73 Taxi lamps
74 Taxi and turn off lamps
75 Landing lamps
76 Navigation lights
77 Anti collision lights
78 Smoke detector units
79 Extinguisher application points
80 Gallery and CO_2 spray points
81 Underfloor ventilation ducts
82 Vent pipe for No. 4 tanks on top of wing tip
83 Engine zone No. 1
84 Engine zone No. 2
85 Crash deflection switches
86 Methyl-bromide bottles, zone No. 1
87 Methyl-bromide bottles, zone No. 2
88 "Firewire" system, includes doors
89 Temperature-sensitive switches each side
90 Firewalls
91 Lower half removable for engine installation
92 Hydraulic service bay hatch
93 Reservoirs, accumulators, electric pump, cut-outs, selector valves
94 Accumulators—yellow, emergency system and power control backing
95 Four engine-driven hydraulic pumps
96 Nosewheel jack
97 Steering jack
98 Main gear jacks
99 Wheel door Servodyne and accumulator
100 Flap servo units
101 Air brake jacks
102 Plate type brake-units
103 Aileron servo-unit bay
104 Elevator and rudder servo units
105 Main mounting trunnions
106 Engine front suspension
107 Inlet valve guide-vanes ram
108 Shaft drive to generator

COMET 4B

Reference: page 596



109 Fuel control group
110 Sump and pump group
111 Skin around cut-outs 16 s.w.g.
112 Basic skin 18 s.w.g.
113 R-R. noise-suppression nozzles
114 Outlet from compressor bleed valves
115 Engine cooling air outlet
116 Forward ducting removed
117 Jet pipes diverge from fuselage to reduce blast
118 Refrasil stainless steel/silica covering
119 Dielectric hinged nose cap
120 Pressure bulkheads
121 Cockpit floor
122 Control column
123 Hanging rudder pedals
124 Q-feel unit and pitot
125 Aileron spring strut
126 Autopilot trim servo-motor
127 Flying control cable pulleys
128 Cables from pilots' pedestal
129 Captain's chair
130 Navigation station chair
131 Table
132 Wall-mounted instruments and oxygen regulators
133 Pilots' flight panel
134 Flight systems officer to starboard
135 Radio racks
136 A.S.I. pressure heads
137 Galley box stowage
138 Toilets (one forward, two aft)
139 Waste water tanks
140 Three toilet servicing points
141 Six 26in x 29in emergency hatches
142 Full size emergency door to starboard
143 Escape chute stowage
144 Nose equipment-bay hatch
145 Passenger door
146 Dome freight compartment
147 Large vestibule
148 Production breaks
149 D.H. undercarriage units, forged main members
150 Access to hinge-pins
151 Dragstays
152 Coupled wheels 30 x 9.00 Dunlop tyres
153 Static-discharge whip, nose-wheel leg
154 Static dischargers
155 Towing points
156 Doors linked to leg
157 Control cables in under-floor ducts except at centre section
158 Static vents on skin
159 Jacking points
160 Sockets for datum levelling bar
161 Sockets for rigging sighting rods
162 Freight hold doors on bungee cord
163 Fresh-water tank in roof
164 Rear freight hold
165 .030in glass-fibre wall and roof liners; alloy floor
166 Lashing points
167 Fuselage/centre-section links
168 Elevator and rudder cable compensators
169 Rear fuselage access hatch
170 Tail bumper
171 Balance tabs
172 Mass balance
173 Dinghy stowage
174 Scissor link between plain flaps
175 Split flaps
176 Forged intake rings in spar web
177 Undercarriage beams
178 Main shock absorber strut
179 Damper shock absorber strut
180 Rocker beam
181 Articulated beam axle
182 Brake torque rods
183 26 x 10.00 Dunlop tyres
184 Door closed except during retraction or extension, starboard shown disconnected
185 Spar joint and dihedral from Rib 7
186 Stringers Reduxed to skin, ends riveted
187 Extensive use o machined skin on inner wings
188 Flow spoiler
189 Fresh-water servicing point
190 Fuel drains
191 Airbrake surfaces top and bottom, additional airbrake above inner plane flap

FLIGHT

AIRLINE OPERATORS' REFERENCE DRAWINGS

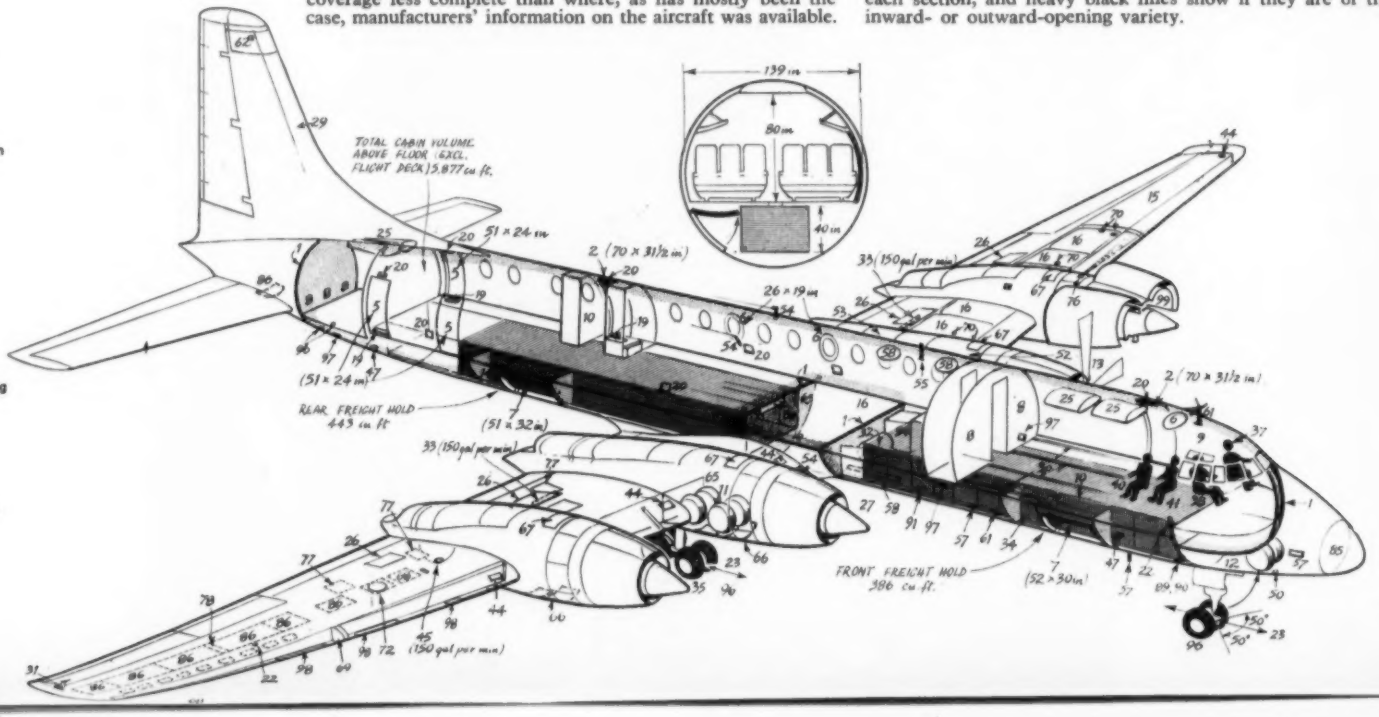
1 Pressure bulkheads
2 Passenger door
3 Crew door
4 Service door
5 Emergency exit (door)
6 Emergency exit (window)
7 Cargo doors
8 Fixed toilets
9 Radio racks
10 Galley, pantry or buffet
11 Main undercarriage well
12 Nosewheel well
13 Reverse-pitch propellers
14 Diplomatic mail locker
15 Integral fuel tanks
16 Bag tanks
17 Reverse thrust
18 Noise suppressors
19 Escape chutes
20 Escape ropes
21 Folding entry stairs (optional)
22 Jacking points
23 Towing points
24 Water methanol tank
25 Water tanks
26 Dinghy stowage
27 Intake to de-icing system
28 Intake to air conditioning system
29 Electrical de-icing
30 Seat rails
31 De-icing system access
32 Hydraulic tank
33 Fuel jettison
34 Batteries
35 Anti-skid device
36 Air brakes
37 Captain
38 First Officer
39 First Officer/Navigator
40 Navigator
41 Engineer
42 Radio operator
43 Braking parachute
44 Gravity fuel fillers
45 Pressure refuelling/defuelling equipment
46 Oil fillers
47 Water fillers
48 Water methanol fillers
49 Signal cartridge dischargers
50 Oxygen filler
51 Windscreen de-icing filler
52 Hydraulic fluid filler
53 Press-accumulator filler/inflator
54 H.F./M.F.
55 V.H.F.
56 V.O.R.
57 D.M.E.
58 A.D.F.
59 Radio altimeter
60 General access panel
61 I.L.S.
62 Loran
63 Electrical service bay
64 Hydraulic service bay
65 Air conditioning equipment

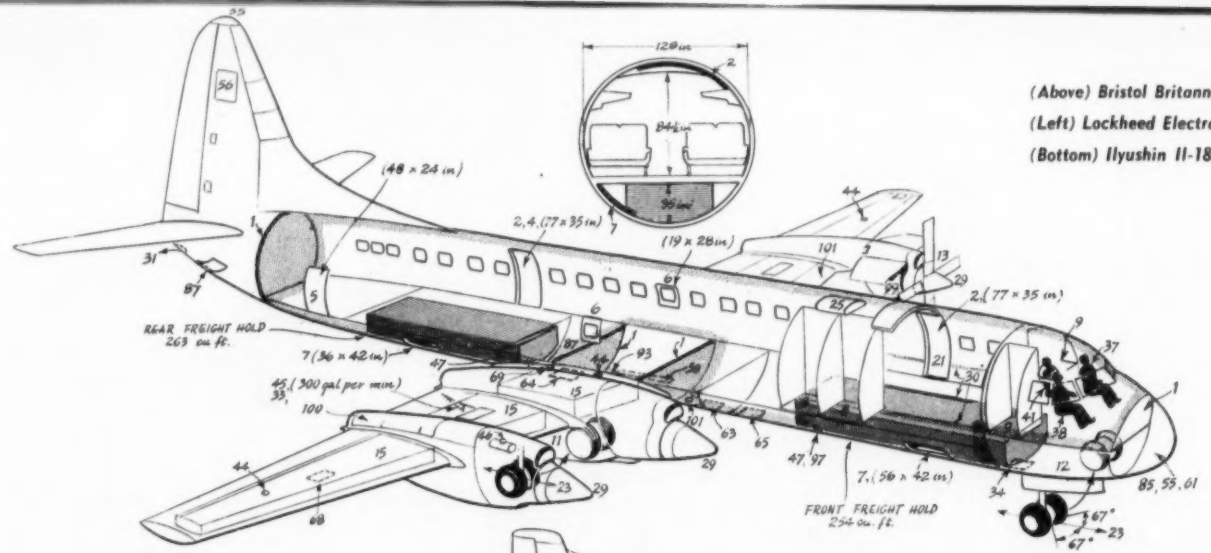
THE drawings on these six pages have a special purpose. They have been drawn to show the tasks for which an aeroplane can be used and some of the features that are in constant use when the aircraft is in service.

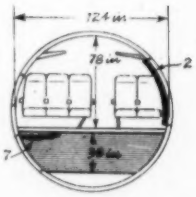
Thus the drawings are an aid not only as a quick reference to bulk sizes (except for the obviously smaller Britannic and Super Hercules, fuselage lengths are approximately to scale) but also as a guide to cabin dimensions, and doors, and methods of opening, and to access hatches and so on.

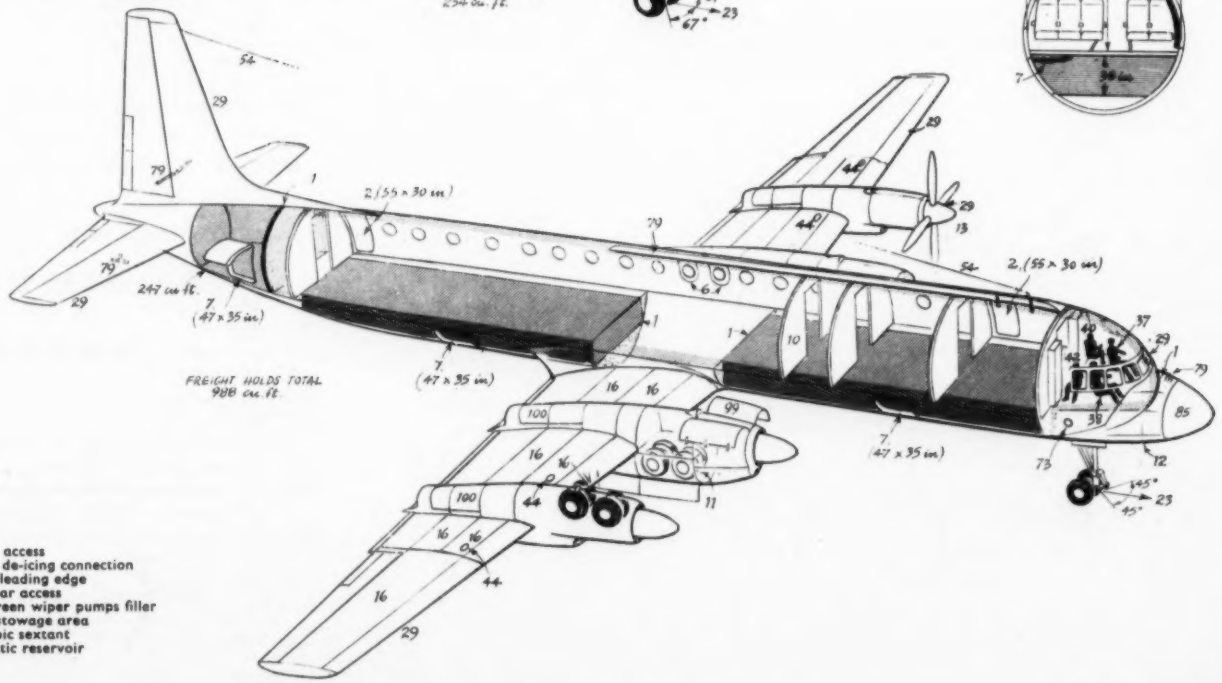
Obviously, the 107 references on the key are not exhaustive and in some cases—notably with the Russian Tu-114 and Il-18—reliance upon photographic interpretation has made coverage less complete than where, as has mostly been the case, manufacturers' information on the aircraft was available. The absence of any particular reference in the key on one drawing does not necessarily imply that this particular item is not to be found on the aircraft to which the drawing refers.

The key, which is identical for each type and repeated on each pair of pages, is an indicator of the information that is given for most of the aircraft shown. In general, the outline of the pressurized volume is lightly shaded, while line-tone shading is used to delineate freight and baggage space. Volumetric capacities are given nearby. Seating shown in the cross-section is a typical layout shown by the manufacturer, i.e., four, five or six abreast and—a disclaimer—the sketches do not represent any particular make of chair. Fuselage doors are shown on each section, and heavy black lines show if they are of the inward- or outward-opening variety.


139 in
80 in
40 in
TOTAL CABIN VOLUME ABOVE FLOOR (EXCL. FLIGHT DECK) 5,877 cu ft.
51 × 24 in
2 (70 × 31½ in)
26 × 19 in
35 (150 gal per min)
(51 × 24 in)
REAR FREIGHT HOLD 443 cu ft
(51 × 32 in)
FRONT FREIGHT HOLD 386 cu ft.
(52 × 30 in)
45 (150 gal per min)







(Above) Bristol Britannia 320. Reference: page 586

(Left) Lockheed Electra. Reference: page 612

(Bottom) Ilyushin Il-18. Reference: page 610

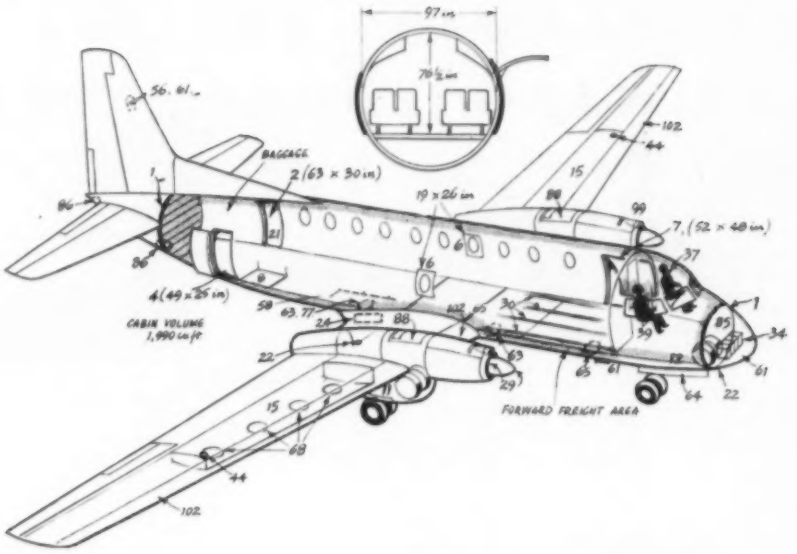
66 Fire suppression bottles
67 Fire control valves
68 Fuel tank access
69 Booster pump access
70 Gauge unit access
71 Fuel tank overflow valve
72 Landing lamp
73 Taxi lamp
74 Landing/taxi lamp
75 Anti-collision beacon
76 Icing inspection lamps
77 Flap gear access
78 Control lock jack access
79 Aerials
80 Generator
81 Bleed door
82 Thermocouples
83 Engine hoist
84 Low pressure fuel cock
85 Weather radar
86 Flying control access
87 Flying control power unit access
88 Auxiliary gearbox
89 Ground intercom. socket
90 External electrical supply
91 Ground air conditioning connection
92 Fire access
93 Access to wing joint
94 Access to gyro compass unit
95 Compass deflector unit
96 Picketing points
97 Toilet servicing points
98 Fuel pipe access
99 Engine access
100 Jet pipe access
101 Ground de-icing connection
102 Hinged leading edge
103 Trim gear access
104 Windscreen wiper pumps filler
105 Spares stowage area
106 Periscopic sextant
107 Pneumatic reservoir

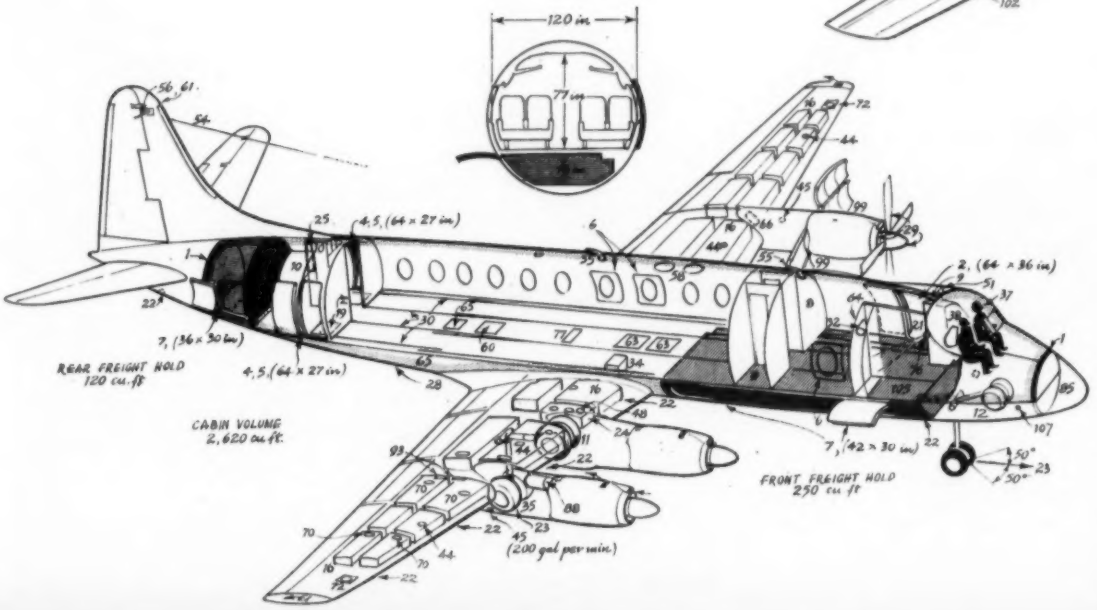
COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

FLIGHT

AIRLINE OPERATORS' REFERENCE DRAWINGS

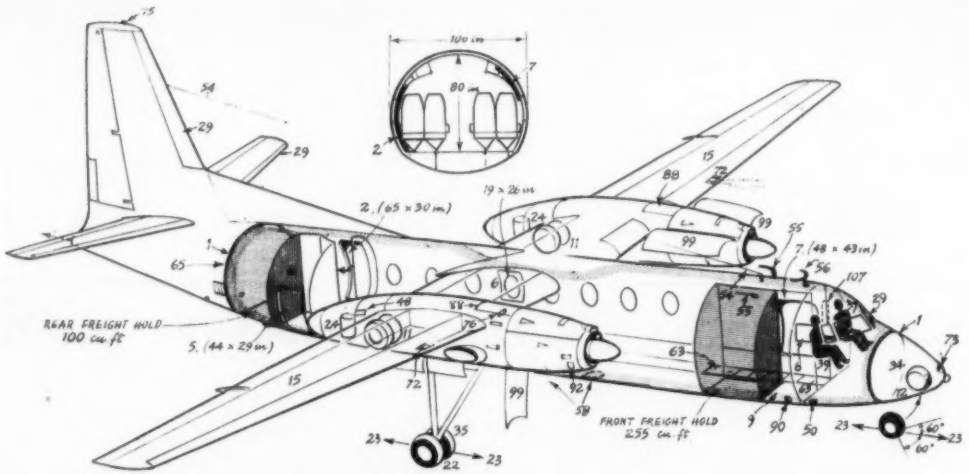




(Above) Avro 748. Reference: page 579
(Left) Vickers Viscount 810. Reference: page 620

1 Pressure bulkheads
2 Passenger door
3 Crew door
4 Service door
5 Emergency exit (door)
6 Emergency exit (window)
7 Cargo doors
8 Fixed toilets
9 Radio racks
10 Galley, pantry or buffet
11 Main undercarriage well
12 Nosewheel well
13 Reverse-pitch propellers
14 Diplomatic mail locker
15 Integral fuel tanks
16 Bag tanks
17 Reverse thrust
18 Noise suppressors
19 Escape chutes
20 Escape ropes
21 Folding entry stairs (optional)
22 Jacking points
23 Towing points
24 Water methanol tank
25 Water tanks
26 Dinghy stowage
27 Intake to de-icing system
28 Intake to air conditioning system
29 Electrical de-icing
30 Seat rails
31 De-icing system access
32 Hydraulic tank
33 Fuel jettison
34 Batteries
35 Anti-skid device
36 Air brakes
37 Captain
38 First Officer
39 First Officer/Navigator
40 Navigator
41 Engineer
42 Radio operator
43 Braking parachute
44 Gravity fuel fillers
45 Pressure fuelling/defuelling equipment
46 Oil fillers
47 Water fillers
48 Water methanol fillers
49 Signal cartridge dischargers
50 Oxygen filler
51 Windscreen de-icing filler
52 Hydraulic fluid filler
53 Press-accumulator filler/inflator

54 H.F./M.F.
82 Thermocouples



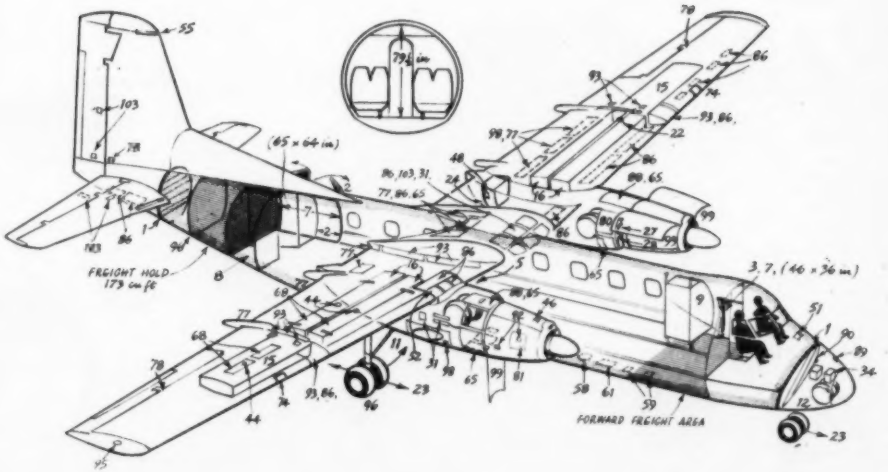
54 H.F./M.F.
55 V.H.F.
56 V.O.R.
57 D.M.E.
58 A.D.F.
59 Radio altimeter
60 General access panel
61 I.L.S.
62 Loran
63 Electrical service bay
64 Hydraulic service bay
65 Air conditioning equipment
66 Fire suppression bottles
67 Fire control valves
68 Fuel tank access
69 Booster pump access
70 Gauge unit access
71 Fuel tank overflow valve
72 Landing lamp
73 Taxi lamp
74 Landing/taxi lamp
75 Anti-collision beacon
76 Icing inspection lamps
77 Flap gear access
78 Control lock jack access
79 Aerials
80 Generator
81 Bleed door
82 Thermocouples
83 Engine hoist
84 Low pressure fuel cock
85 Weather radar
86 Flying control access
87 Flying control power unit access point.
88 Auxiliary gearbox
89 Ground intercom. socket
90 External electrical supply
91 Ground air conditioning connection
92 Fire access
93 Access to wing joint
94 Access to gyro compass unit
95 Compass deflector unit
96 Picketing points
97 Toilet servicing points
98 Fuel pipe access
99 Engine access
100 Jet pipe access
101 Ground de-icing connection
102 Hinged leading edge
103 Trim gear access
104 Windscreen wiper pumps filler
105 Spares stowage area
106 Periscopic sextant
107 Pneumatic reservoir

(Left) Fokker Friendship. Reference: page 608
(Below) Handley Page Dart Herald. Reference: page 609

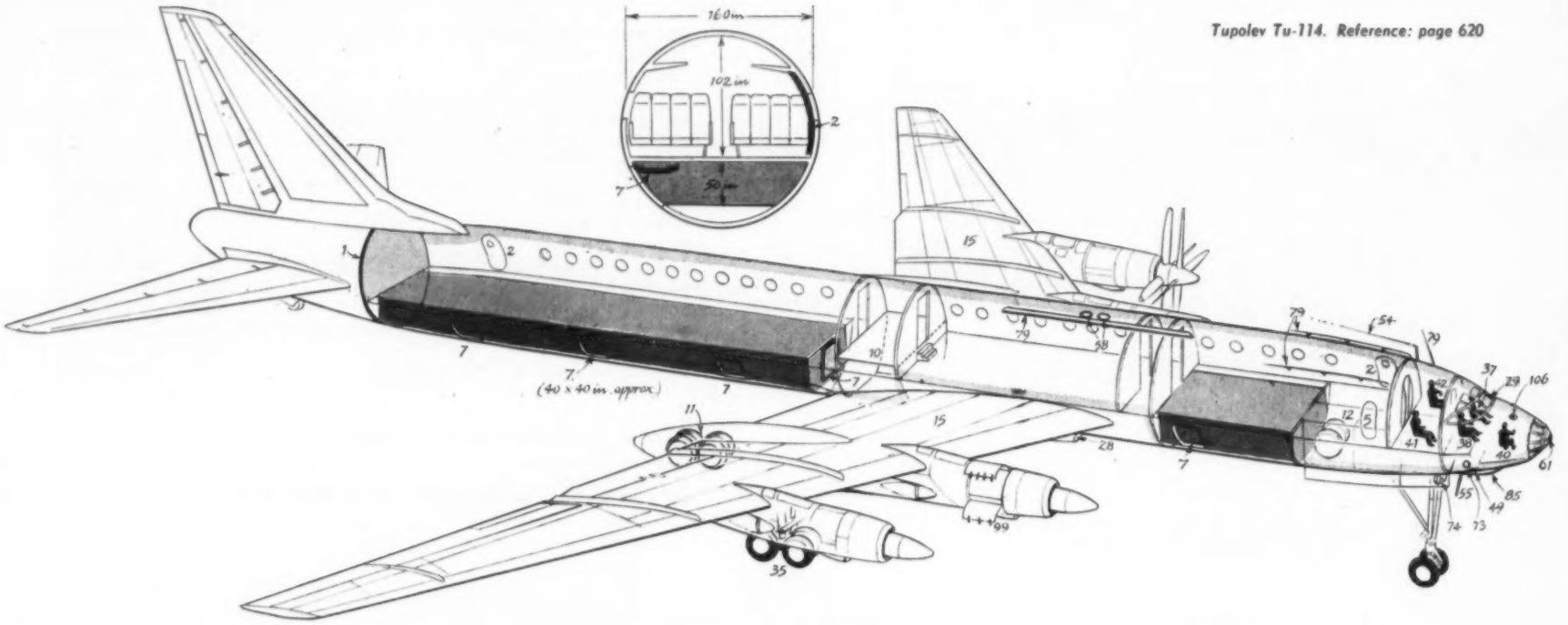
CUTAWAY COMPENDIUM

References to Engineering Cutaway Drawings

Avro 748	**"Flight", May 8, 1959, page 636**
AW.650 Argosy	**pages 580-581**
Britannia 310 and 320	**"Flight", July 25, 1958, pages 116-118**
Boeing 707-420	**pages 584-585**
Canadair CL-44D	**pages 588-589**
Caravelle	**"Flight", July 25, 1958, pages 101-103**
Comet 4B	**pages 598-599**
Convair 600	**pages 590-591**
Douglas DC-8	**pages 594-595**
Electra	**"Flight", July 25, 1958, pages 135-137**
Friendship	**"Flight", July 25, 1958, pages 104-106**
Herald	**"Flight", July 25, 1958, pages 132-133**
Il-18	**"Flight", July 25, 1958, pages 110-111**
Tu-114	**"Flight", July 25, 1958, pages 108-109**
Vanguard	**pages 616-617**
VC.10	**pages 618-619**
Viscount	**"Flight", July 25, 1958, pages 124-126**



Tupolev Tu-114. Reference: page 620



FLIGHT AIRLINE OPERATORS' REFERENCE DRAWINGS

1 Pressure bulkheads
2 Passenger door
3 Crew door
4 Service door
5 Emergency exit (door)
6 Emergency exit (window)
7 Cargo doors
8 Fixed toilets
9 Radio racks
10 Galley, pantry or buffet
11 Main undercarriage well
12 Nosewheel well
13 Reverse-pitch propellers
14 Diplomatic mail locker
15 Integral fuel tanks
16 Bag tanks
17 Reverse thrust
18 Noise suppressors
19 Escape chutes
20 Escape ropes
21 Folding entry stairs (optional)
22 Jacking points
23 Towing points
24 Water methanol tank
25 Water tanks
26 Dinghy stowage
27 Intake to de-icing system
28 Intake to air conditioning system
29 Electrical de-icing
30 Seat rails
31 De-icing system access
32 Hydraulic tank
33 Fuel jettison
34 Batteries
35 Anti-skid device
36 Air brakes
37 Captain
38 First Officer
39 First Officer/Navigator
40 Navigator
41 Engineer
42 Radio operator
43 Braking parachute
44 Gravity fuel fillers
45 Pressure refuelling/defuelling equipment
46 Oil fillers
47 Water fillers
48 Water methanol fillers
49 Signal cartridge dischargers
50 Oxygen filler
51 Windscreen de-icing filler
52 Hydraulic fluid filler
53 Press-accumulator filler/inflator
54 H.F./M.F.
55 V.H.F.
56 V.O.R.
57 D.M.E.
58 A.D.F.
59 Radio altimeter
60 General access panel
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70 Gauge unit access
71 Fuel tank overflow valve
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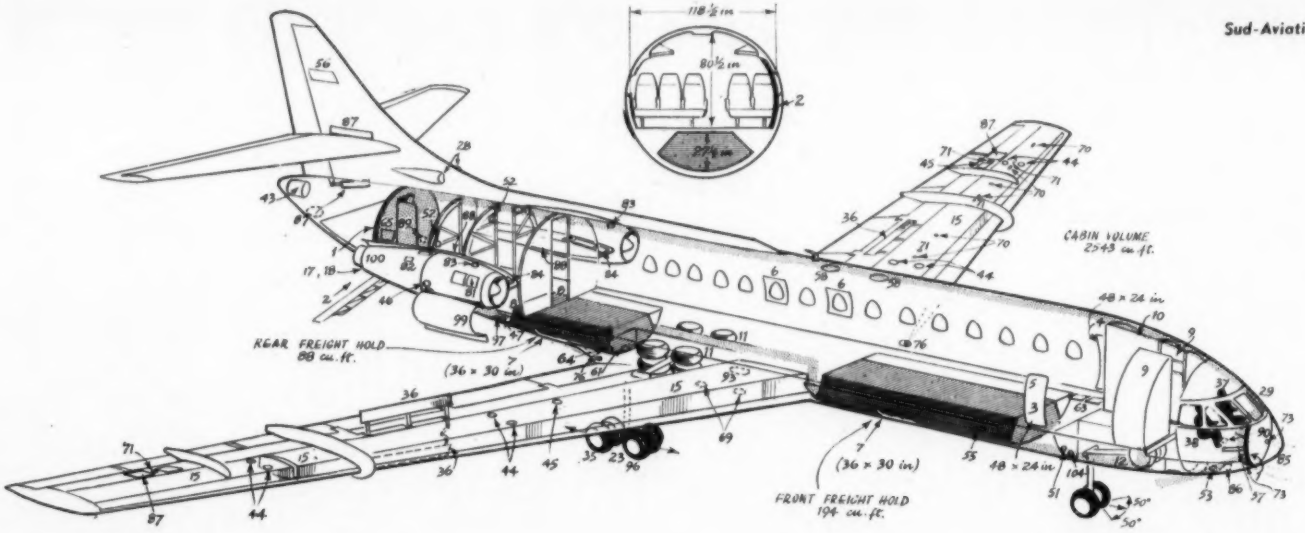
73 Taxi lamp
74 Landing/taxi lamp
75 Anti-collision beacon
76 Icing inspection lamps
77 Flap gear access
78 Control lock jack access
79 Aerials
80 Generator
81 Bleed door
82 Thermocouples
83 Engine hoist
84 Low pressure fuel cock
85 Weather radar
86 Flying control access
87 Flying control power unit access
88 Auxiliary gearbox
89 Ground intercom. socket
90 External electrical supply
91 Ground air conditioning connection
92 Fire access
93 Access to wing joint
94 Access to gyro compass unit
95 Compass deflector unit
96 Picketing points
97 Toilet servicing points
98 Fuel pipe access
99 Engine access
100 Jet pipe access
101 Ground de-icing connection
102 Hinged leading edge
103 Trim gear access
104 Windscreen wiper pumps filler
105 Spares stowage area
106 Periscopic sextant
107 Pneumatic reservoir

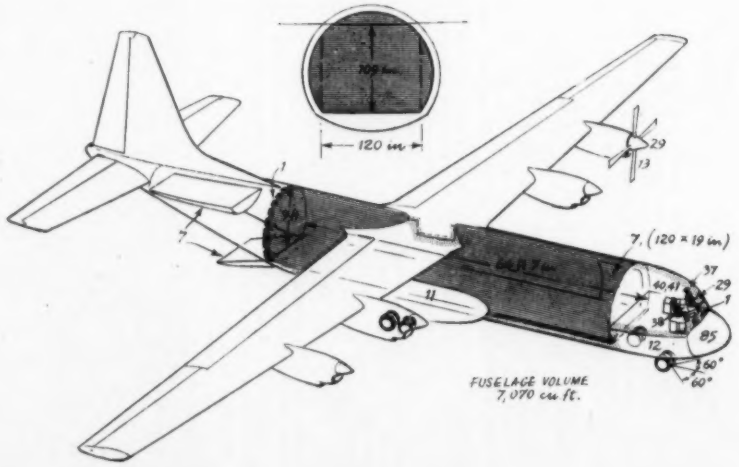
18 Noise suppressors
36 Air brakes
53 Press-accumulator filler/inflator
71 Fuel tank overflow valve
89 Ground intercom. socket
187 Pneumatic reservoir

59

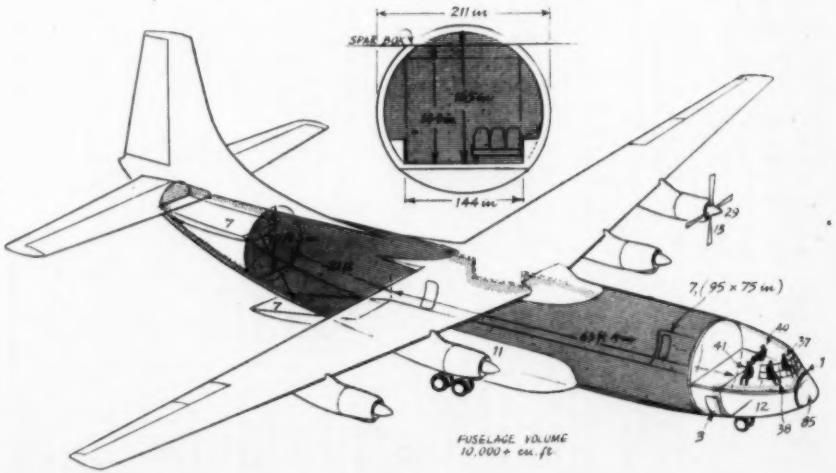
Sud-Aviation Caravelle. Reference: page 615



Lockheed GL-207 Super Hercules. Reference: page 612



Short Britannic 3A. Reference: page 614



605

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

Powerplant: Four Pratt & Whitney R-2000-2SD-13Gs of 1,450 b.h.p. driving three-bladed Hamilton Standard Hydromatic 13ft 1in propellers.

Dimensions: Span, 117ft 6in; length, 93ft 11in; height empty, 27ft 6½in; wing area, 1,463 sq ft.

Weights: Max. take-off, 73,000 lb; landing, 63,500 lb; zero fuel, 63,500 lb; capacity payload, 12,700 lb; weight less usable fuel and payload, 45,950 lb.

Payload accommodation: Cabin volume, 3,775 cu ft; baggage and freight volume, 525 cu ft; cabin length, 63ft 8in; max. width, 9ft 10½in; max. height, 7ft 3in; max. usable floor area, 470 sq ft; dimensions of largest door, 5ft 7in × 7ft 6in; max. seats, 86.

Fuel capacity: 2,990 Imp. gal.

Performance: Cont. cruising speed, 177 kt (204 m.p.h.) at 10,000ft and 64,600 lb; corres. consumption, 1,370 lb/hr; balanced field length, max. take-off weight, S.L., I.S.A., 5,250ft; landing distance from 50ft, 2,760ft; range A (max. payload), 1,860 n.m. (2,140 st.m.); range B (max. fuel), 3,680 n.m. (4,230 st.m.); corres. payload, 11,400 lb; corres. cruise speed, 175 kt (201 m.p.h.).

DC-6 The DC-4 design achieved its full potential as a civil transport only after the end of the Second World War when it appeared in a more powerful stretched and pressurized form known as the DC-6. The DC-6 carries 50-70 passengers on stage lengths of more than 2,500 miles at cruising speeds of up to 280 m.p.h. It is thus considerably faster than its predecessor because of the higher installed power (9,600 h.p. for take-off instead of 5,800 h.p.) and because it can operate at greater heights with its pressurized passenger accommodation. Apart from the more powerful engines and the strengthened structure which they require and which permits higher operating weights, the DC-6 differs from the DC-4 in having double-slotted flaps of increased efficiency which hold down the approach speed of the original domestic model to little more than that of the DC-4, in spite of the much increased landing-weight.

The DC-6 resulted from discussions with United Air Lines about an aeroplane for the U.S. transcontinental routes. This was in 1944 while the War was still in progress; three prototypes were ordered by the U.S.A.A.F. as the XC-112A. The first flight took place on February 15, 1946. After the War, manufacture for the airlines got under way and deliveries to United started in 1947. Some 175 DC-6s were built and 160 are still in service with 23 airlines. The DC-6 cost between £210,000 and £230,000 in 1946/47 and its price rose to about £310,000 in 1951. Resale price today is about £175,000.

Powerplant: Four Pratt & Whitney R-2800-CB-16 of 2,400 b.h.p. driving three-bladed Hamilton Standard Hydromatic 13ft 1in propellers.

Dimensions: Span, 117ft 6in; length, 100ft 7in; height empty, 28ft 5in; wing area, 1,463 sq ft.

Weights: Max. take-off, 97,200 lb; landing, 80,000 lb; zero fuel, 74,000 lb; capacity payload, 14,800 lb; weight less usable fuel and payload, 57,200 lb.

Payload accommodation: Cabin volume, 4,107 cu ft; baggage and freight volume, 374-518 cu ft; cabin length, 63ft 9in; max. width, 9ft 10½in; max. height, 7ft 3in; max. usable floor area, 553 sq ft; dimensions of largest door, 3ft × 6ft; max. seats, 86.

Fuel capacity: 3,550 Imp. gal (4,260 U.S.); water-methanol, 33 Imp. gal.

Performance: Cont. cruising speed, 271 kt (312 m.p.h.) at 19,600ft and 73,000 lb; corres. consumption, 350 Imp. gal/hr; balanced field length, max. take-off weight, S.L., I.S.A., 5,400ft; at 4,000ft I.S.A., 7,270ft at 84,000 lb; landing distance from 50ft, 2,970ft; range A (max. payload), 2,900 n.m. (3,330 st.m.); range B (max. fuel), 3,400 n.m. (3,910 st.m.); corres. payload 17,700 lb; corres. cruise speed, 244 kt (280 m.p.h.).

DC-6A The success of the DC-6 suggested that further improvements in specific operating costs could be achieved with this same basic design by simply expanding its payload capacity. This was done with great success with the DC-6A, which appeared in 1949. Some were subsequently converted to passenger use and a mixed passenger/freighter version, the **DC-6C** was produced. Some 75 DC-6As and 6Cs were built for commercial operators of which 73 are still in service with 23 airlines. In addition, 167 military models of the DC-6A have been supplied to the U.S. Services. The DC-6A cost between £335,000 and £400,000 in 1951/2. Price asked today is about £296,000.

Powerplant: Four Pratt & Whitney R-2800-CB-17 of 2,500 b.h.p. driving three-bladed Hamilton Standard Hydromatic 13ft 6in propellers.

Dimensions: Span, 117ft 6in; length, 105ft 7in; height empty, 28ft 8in; wing area, 1,463 sq ft.

Weights: Max. take-off, 107,000 lb; landing, 88,200 lb; zero fuel, 83,200 lb; capacity payload, 28,188 lb; weight less fuel and payload, 57,000 lb.

Payload accommodation: Cabin volume, 4,360 cu ft; baggage and freight volume, 539 cu ft; cabin length, 68ft; max. width, 9ft 10½in; max. height, 7ft 3in; max. usable floor area, 596 sq ft; dimensions of largest door, 6ft 6½in × 10ft 4in; max. seats, 107.

Fuel capacity: 4,600 Imp. gal (5,520 U.S. gal); water-methanol, 33 Imp. gal.

Performance: Cont. cruising speed, 274 kt (315 m.p.h.) at 22,500ft and 88,200 lb; corres. consumption, 350 Imp. gal/hr; balanced field length, max. take-off weight, S.L., I.S.A., 6,150ft; at 5,000ft, I.S.A., 5,420ft at 90,000 lb; landing distance from 50ft, 3,100ft; range A (max. payload), 2,540 n.m. (2,920 st.m.); range B (max. fuel), 4,100 n.m. (4,720 st.m.); corres. payload, 17,580 lb; corres. cruise speed, 230 kt (265 m.p.h.).

Douglas DC-8 of T.C.A. (Rolls-Royce Conway by-pass turbojets)

DC-6B The DC-6B passenger airliner was the logical outcome of the DC-6A freighter. It had a fuselage lengthened by another 13in and dispensed with the various special freighting provisions of its predecessor. It will accommodate between 60 and 100 passengers depending on the layout. The first DC-6B flew on February 2, 1951, and the type went into service with Western Air Lines in April of the same year. Flown by American Airlines on the prestige "coast-to-coast" routes, the DC-6B was for a time the fastest equipment in use. However, it was not so much for its performance, which does not differ greatly from that of the DC-6, as for its excellent economics that the DC-6B was to gain a great reputation, remain longer in production and be built in greater numbers than any other of the later developments of the DC-4. It is probable that lower seat-mile costs have, in fact, been achieved with DC-6Bs than with any other piston-engined equipment. A total of 287 DC-6Bs were produced and production was not completed until late in 1958, when manufacture of the DC-8 jet transport was getting under way; 271 are still in service with 29 airlines. The DC-6B cost about £400,000 in 1951. This increased to about £500,000 in 1958, and resale price today is about £227,000.

Powerplant: As DC-6A.

Dimensions: As DC-6A, except: length, 106ft 8in.

Weights: As DC-6A, except: capacity payload, 19,200 lb; weight less fuel and payload, 64,000 lb.

Payload accommodation: As DC-6A.

Fuel capacity: As DC-6A.

Performance: Cont. cruising speed, 274 kt (315 m.p.h.) at 22,500ft and 88,200 lb; corres. consumption, 350 Imp. gal/hr; balanced field length, max. take-off weight, S.L., I.S.A., 6,150ft; at 5,000ft I.S.A., 5,420ft at 90,000 lb; landing distance from 50ft; 3,100ft; range A (max. payload), 2,650 n.m. (3,050 st.m.); range B (max. fuel), 4,100 n.m. (4,720 st.m.); corres. payload, 14,000 lb; corres. cruise speed, 230 kt (265 m.p.h.).

DC-7 This further development of the DC-4 family owed its origins to the competitive pressures on the domestic routes within the United States and particularly to the struggle between the airline "giants," American, United and T.W.A., on the transcontinental routes. In 1950 T.W.A. ordered from Lockheed a stretched version of the Constellation, the L.1049C with the new powerful Wright Turbo-Compound engine. This aircraft was obviously going to outpace the DC-6B then in service and would, for the first time, offer non-stop coast-to-coast capability. American Airlines accordingly ordered from Douglas an equivalent development of the DC-6B using the same compound engine.

Although fast, the DC-7 is perhaps an example of a transport aeroplane which has been developed beyond the point of diminishing returns. Although the type served its purpose admirably—indeed, 120 were built—its economic characteristics are inferior to those of the DC-6B and the powerful engines give a relatively high noise and vibration level in the cabin. A total of 118 DC-7s are still in service today with four airlines. The cost was about £570,000; price today is very much lower. *Flight* description: July 30, 1954.

Powerplant: Four Wright R-3350-988 TC-18 DA-4 Turbo-Compounds of 3,250 b.h.p. driving four-bladed Hamilton Standard Hydromatic 13ft 6in propellers.

Dimensions: Span, 117ft 6in; length, 108ft 11in; height empty, 28ft 7in; wing area, 1,463 sq ft.

Weights: Max. take-off 122,200 lb; landing, 97,000 lb; zero fuel, 91,000 lb; capacity payload, 20,000 lb.

Payload accommodation: Cabin volume, 4,647 cu ft; baggage and freight volume, 983 cu ft; cabin length, 84ft; max. width, 9ft 10½in; max. height, 7ft 3in; max. usable floor area, 625 sq ft; dimensions of largest door, 3ft × 6ft; max. seats, 99.

Fuel capacity: 4,600 Imp. gal (5,520 U.S. gal).

Performance: Cont. cruising speed, 312 kt (358 m.p.h.) at 24,200ft and 105,000 lb; corres. consumption, 420 Imp. gal/hr: balanced field length, max. take-off weight, S.L., I.S.A., 6,060ft; at 5,000ft I.S.A., 7,320ft at 118,800 lb; landing distance from 50ft, 5,520ft at 95,000 lb; range B (max. fuel), 3,770 n.m. (4,430 st.m.).

DC-7B The DC-7B is similar to the DC-7 but is fitted with extra tankage for long-haul overwater operation and is cleared for higher weights. The DC-7B first flew on April 25, 1955, and entered service with Pan American less than a month later. A total of 97 DC-7Bs were built, of which 95 are still in service with seven airlines. The price of the DC-7B increased from about £680,000 in 1955 to about £820,000 in 1957. Resale price today is low.

Powerplant: As DC-7.

Dimensions: As DC-7.

Weights: Max. take-off, 126,000 lb; landing, 102,000 lb; zero fuel, 96,000 lb; capacity payload, 21,516 lb; weight less fuel and payload, 74,000 lb.

Payload accommodation: As DC-7.

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

Fuel capacity: 5,380 Imp. gal (6,460 U.S. gal).

Performance: Cont. cruising speed, 313 kt (360 m.p.h.) at 24,300ft and 102,000 lb; corres. consumption, 420 Imp. gal/hr; balanced field length, max. take-off weight, S.L., I.S.A., 6,350ft, at 5,000ft, I.S.A., 7,650ft at 122,600 lb; landing distance from 50ft, 5,950ft; range A (max. payload), 2,850 n.m. (3,280 st.m.); range B (max. fuel), 4,275 n.m. (4,910 st.m.); corres. payload, 11,600 lb; corres. cruise speed, 248 kt (285 m.p.h.).

DC-7C The DC-7 and DC-7B were criticized in service for their relatively high interior noise and vibration levels, which resulted from the 3,250 b.h.p. Wright compound engines in an airframe designed originally (as the DC-4) for units of 1,450 h.p. This led Pan American to discuss with Douglas ways of improving the design while stretching it still further to provide non-stop North Atlantic range. Ability to fly the North Atlantic routes non-stop on a high percentage of occasions in the critical Westbound direction against the strong prevailing winds had long been a major objective of all the competing Atlantic carriers, so that the DC-7C marked an important step forward both operationally and commercially. Douglas developed the DC-7C from the DC-7B in the short space of about a year, extending the wing by the insertion of an additional 10ft of centre section. Altogether 121 DC-7Cs were sold. This was the last stretch of the famous DC-4/7 series. The DC-7C finally went out of production late in 1958 at the same time as the DC-6B; 117 are still in service with twelve airlines. The DC-7C cost about £800,000 in 1956 and increased to about £930.000 by 1958. The price today is very much lower. *Flight* description: July 6, 1956, page 51.

Powerplant: Four Wright R-3350-988 TC-18 EA-4 Turbo-Compounds of 3,400 b.h.p. driving four-bladed Hamilton Standard 14ft propellers.

Dimensions: Span, 127ft 6in; length, 112ft 3in; height empty, 31ft 10in; wing area, 1,637 sq ft.

Weights: Max. take-off, 143,000 lb; landing, 111,000 lb; zero fuel, 101,500 lb; capacity payload, 23,350 lb; weight less fuel and payload, 82,000 lb.

Payload accommodation: Cabin volume, 4,863 cu ft; baggage and freight volume, 1,149 cu ft; cabin length, 87ft 4in; max. width, 9ft 10½in; max. height, 7ft ¾in; max. usable floor area, 654 sq ft; dimensions of largest door, 3ft × 6ft; max. seats, 99.

Fuel capacity: 6,515 Imp. gal (7,810 U.S. gal).

Performance: Cont. cruising speed, 308 kt (354 m.p.h.) at 23,500ft and 110,000 lb; corres. consumption, 420 Imp. gal/hr; balanced field length, max. take-off weight, S.L., I.S.A., 6,400ft; at 5,000ft, I.S.A., 7,690ft at 136,800 lb; landing distance from 50ft, 5,450ft at 109,000 lb; range A (max. payload), 4,000 n.m. (4,600 st.m.); range B (max. fuel), 4,900 n.m. (5,630 st.m.); corres. payload, 15,300 lb; corres. cruise speed, 238 kt.

DC-7F Douglas are converting to special order a number of DC-7s for all-freight use, designated DC-7F.

Conversion orders for the DC-7F have been placed by American Airlines (ten, the first of which are now in service); PanAm (ten) and United (six, from February 1960). The modification cost of the ten A.A. aircraft is £1.5m ($4,250,000). *Flight* reference: November 6, 1959.

Basic data: Max. take-off weight, 126,000 lb; max. payload (domestic), 34,600 lb; (intercont.), 31,600 lb; cruise speed, 304 kt (350 m.p.h.).

DC-8 Latest addition to the world's most respected family of airliners was announced in 1955, first flown on May 30, 1958, certificated (JT3 domestic model) on August 31, 1959, and introduced into service simultaneously by United Air Lines and Delta on September 18, 1959. A total of 145 have been ordered by 20 airlines.

Like its rival the Boeing 707, the DC-8 is offered in a variety of versions: there are two domestic and two international models, with different tankages and engines—all versions (unlike the 707) being dimensionally identical.

The domestic DC-8s are powered either by Pratt & Whitney JT3C or JT4A engines; the international versions have JT4As or Rolls-Royce Conways. Two operators (K.L.M. and Iberia) have specified P. & W. JT3D turbofans. The order book and delivery dates as this issue went to press were (int. = international model, dom. = domestic model):—

Pan American, 17 int. JT4A, from December 1959; *United*, 40 dom. (22 JT3C, 18 JT4A), current; *K.L.M.*, 12 int. (seven JT4A, five JT3D turbofans) from January 1960; *Eastern*, 16 dom. JT4A, current; *T.A.L.*, 4 int. JT4A, from September 1960; *S.A.S.*, 7 int. JT4A, from March 1960; *Panagra*, 4 int. JT4A (via PanAm), February 1960; *Panair do Brasil*, 4 int. JT4A (via PanAm), 1960; *Delta*, 6 dom. (two JT3C, four JT4A), current; *Swissair*, 3 int. JT4A, from March 1960; *U.A.T.*, 2 int. JT4A, from March 1960; *T.A.I.*, 2 int. JT4A, from June 1960; *Olympic*, 2 int. JT4A, 1960; *Trans-Caribbean*, one dom. JT3C, December 1960; *Northwest*, 5 int. JT4A, 1960; *National*. 3 dom. JT4A, 1960; *T.C.A.*, 6 int. Conway, from late 1959; *Alitalia*, 4 int. Conway, from summer 1960; *Iberia*, 3 int. JT3D turbofans, 1961; *C.P.A.L.*, 4 int. Conway, 1961.

Cutaway drawing and general arrangement: pages 594 and 595. *Flight* references: July 25, 1958; November 1, 1957; July 6, 1956. Basic price (JT4 domestic): £1.86m.

Domestic JT3 DC-8

Powerplant: Four Pratt & Whitney JT3C-6 turbojets of 13,500 lb static thrust each with water injection.

Dimensions: Span, 142ft 5in; length, 150ft 6in; height empty, 42ft 4in; wing area, 2,770.6 sq ft.

Weights: Max. take-off, 273,000 lb; landing, 190,500 lb; zero fuel, 162,400 lb; capacity payload, 36,285 lb; weight less fuel and payload, 126,115 lb.

Payload accommodation: Cabin volume, 7,945 cu ft; baggage and freight volume, 1,390 cu ft; cabin length, 103ft; max. width, 11ft 4in; max. height, 6ft 8in; max. usable floor area, 1,100 sq ft; dimensions of largest door, 32in × 72in; max. seats, 176.

Fuel capacity: 14,120 Imp. gal (16,950 U.S. gal).

Performance: NOT AVAILABLE. At the request of Douglas all DC-8 performance data have been omitted. Estimated data for all models appeared on page 142 of *Flight* for July 25, 1958. *Particulars for other models where they differ from those given above:—*

Domestic JT4 DC-8

Powerplant: Four Pratt & Whitney JT4A-3 turbojets of 15,800 lb static thrust. No water injection.

Weights: Max. take-off, 276,000 lb; landing, 189,000 lb; zero fuel, 162,500 lb; capacity payload, 33,328 lb (weight limited); weight less fuel and payload, 129,172 lb.

Intercontinental JT4 DC-8

Powerplant: Four Pratt & Whitney JT4A-11 turbojets of 17,500 lb static thrust. No water injection.

Weights: Max. take-off 310,000 lb; landing, 199,500 lb; zero fuel, 174,600 lb; capacity payload, 40,519 lb (weight limited); weight less fuel and payload, 134,081 lb.

Fuel capacity: 18,600 Imp. gal (22,350 U.S. gal).

Intercontinental Turbofan DC-8

Powerplant: Four Pratt & Whitney JT3D-1 turbofans of 17,000 lb static thrust (no water injection), *or* four Pratt & Whitney JT3D-3 turbofans of 18,000 lb static thrust (no water injection).

Weights: Max. take-off 310,000 lb; landing, 199,500 lb; zero fuel, 168,500 lb; capacity payload, 49,098 lb; weight less fuel and payload, 128,402 lb.

Fuel capacity: As for JT4 Intercontinental model.

Intercontinental Conway DC-8

Powerplant: Four Rolls-Royce Conway RCo.12 turbojets of 17,500 lb static thrust. No water injection.

Weights: Max. take-off, 310,000 lb; landing, 199,500 lb; zero fuel, 174,600 lb; capacity payload, 41,482 lb; weight less fuel and payload, 133,118 lb.

Fuel capacity: As for JT4 Intercontinental.

DC-9 Announced in July 1959 after three years of design-studies, the 68-92-seat DC-9 is intended as a DC-6B replacement for the short-medium stages of up to 2,500 miles. It falls approximately in the Airco D.H.121 class, and it is cast in the image of the DC-8, with four underwing podded engines (JTF10A-1 turbofans), though it is reported that a twin-engined version (JT3D turbofans) is being offered also. No orders have been placed: production will start if initial orders for 75-100 are received. It was stated in July that deliveries could be made for operation early in 1963.

Powerplant: Four Pratt & Whitney JTF10A-1 of 8,250 lb static thrust each. (Alternative: two P. & W. JT3D of 17,000 lb.)

Dimensions: Span, 94ft; length, 103ft; height, 34ft; wing area, 1,285 sq ft.

Weights: Max. take-off, 120,000 lb; landing, 98,000 lb; zero fuel, 87,000 lb; capacity payload, 20,355 lb.

Payload accommodation: Cargo capacity, 609 cu ft; cabin length, 71ft; max. width, 10ft 4in; max. height, 6ft 9in; max. seats, 92.

Fuel capacity: Not published.

Performance (JTF10A-1, 68 first-class passengers and baggage): Cont. cruise speed, 481 kt (554 m.p.h.) at 35,000ft over 650 n.m. (750 st.m.) stage with 98,200 lb take-off weight; balanced field length, max. take-off weight, S.L., I.S.A., 5,950ft; S.L. and 15 deg C, 6,840ft; landing distance (F.A.A.), 4,800ft; stage length, 2,560 n.m. (2,950 st.m.).

FAIRCHILD *Fairchild Aircraft and Missiles Division, Fairchild Engine and Airplane Corporation, Hagerstown, Maryland, U.S.A.*

F-27 Construction of the F-27 by Fairchild in America followed from a long-standing association of Fokker and Fairchild. An agreement was

Fairchild (Fokker licence) F-27 of Pacific Air Lines (Rolls-Royce Dart turboprops)

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

concluded in April 1956 and work began two months later, and the first Hagerstown-built aircraft flew on April 12, 1958. Certification at 35,700 lb weight was obtained on October 29, 1957.

Three versions are offered by the U.S. manufacturer: a local service airliner with up to 44 seats, an executive aircraft with provision for 1,380 Imp. gal fuel, and a cargo aircraft (the **F-27B**) with a strengthened floor and a larger forward door. Most of Fairchild's airline customers—which now total 12—have specified the higher-powered Rolls-Royce Darts, but both RDa.6 and RDa.7 versions are on offer. U.S.-built aircraft include some American equipment and provision is made for nose radar. First delivery was to West Coast Airlines on June 22, 1958, and this airline inaugurated the world's first Friendship services on September 28, 1958. Basic price of the RDa.6 F-27, recently increased by 10 per cent, is about £239,000. Order book: see *Flight*, November 13.

Powerplant: As Fokker F.27.

Dimensions: As Fokker F.27 except length, 77ft 2in.

Weights: Max. take-off, 36,500 lb; max. landing, 36,000 lb; zero fuel, 34,000 lb; capacity payload, 10,193 lb; weight less fuel and payload 23,807 lb.

Payload accommodation: Cabin volume (less flight deck), 2,118 cu ft; baggage and freight volume, 162 cu ft; cabin length (total) 47ft 4in; max. usable floor area (less flight deck) 225.5 sq ft; max. seats, 44. Remainder as Fokker F.27.

Fuel capacity: As Fokker F.27.

*Performance:** Cont. cruise speed, 260 kt (300 m.p.h.) at 20,000ft and 33,000 lb; corres. specific fuel consumption, 0.632 lb/s.h.p./hr; actual landing distance from 50ft, 2,195ft; range A (max. payload), 350 n.m. (404 st.m.); range B (max. fuel), 2,100 n.m. (2,412 st.m.); corres. payload, 2 passengers; corres. cruising speed, 208 kt (240 m.p.h.).

*RDa.7 version.

FAIREY *Fairey Aviation Ltd., Hayes, Middlesex.*

Rotodyne See Helicopters of the World, *Flight*, May 15, 1959.

D.H.121 Fairey is a partner in the Airco D.H.121. See page 578.

FOKKER *Royal Netherlands Aircraft Factories Fokker, Schiphol-Z, Amsterdam, Holland.*

F.27 Friendship Conceived early in 1951 as a faster, greater-capacity feederliner replacement for the Douglas DC-3, the Friendship met with a ready response and has so far been the most successful of the competing aircraft in this category.

An early order for two was placed by K.L.M. (delivery: April and May, 1960). The first of four prototypes—it was 36in shorter than the second and all subsequent aircraft—flew initially on November 24, 1955. First flight of the first production aircraft was made in March 1958 and this was delivered to Aer Lingus on November 19, 1958, who became the first operator of Fokker-built Friendships when they inaugurated services between Dublin and Liverpool/Glasgow on December 15, 1958. Services to Paris began two days later.

In September approval was given for an increase in maximum take-off weight from 35,700 lb to 37,500 lb and in maximum landing weight from 34,000 lb to 35,700 lb. A freighter with large loading doors—the **Freightship**—can also be supplied, and ten have been ordered. Full order book: see *Flight*, November 13, adding N.Z. National Airways (4).

It is reported that I.A.C. may buy five Friendships until their turboprop plans are firm. The basic price of the Friendship is £218,000 less radio.

References in *Flight*: July 25, 1958; April 3, 1959. Airline operators' reference drawing, page 603.

Powerplant: Two Rolls-Royce Dart RDa.6 turboprops of 1,600 s.h.p. + 370 lb take-off thrust driving Rotol 12ft propellers or two RDa.7s of 1,910 s.h.p. + 505 lb thrust driving Rotol 11.5ft propellers.

Dimensions: Span, 95ft 2in; length, 75ft 9in; height empty, 22ft 6in; wing area, 756 sq ft.

Weights: Max. take-off, 37,500 lb; max. landing, 35,700 lb; zero fuel, 34,000 lb; capacity payload (RDa.6), 10,148 lb, (RDa.7), 9,632 lb, Freightship (RDa.6), 10,586 lb; weight less fuel and payload (RDa.6), 22,252 lb, (RDa.7), 22,768 lb, Freightship (RDa.6), 21,814 lb.

Payload accommodation: Cabin volume (total) 2,118 cu ft; baggage and freight volume (32-passenger layout) 355 cu ft; cabin length between partitions (32-passenger), 33ft 7in; (Freightship), 47ft; max. interior width, 100in; max. interior height, 79½in; max. usable floor area, 279 sq ft; dimensions of largest door, 47 × 41in, (Freightship), 91.5 × 70in; max. seats, 48.

Fuel capacity: 1,114 Imp. gal plus 66 Imp. gal water-methanol.

Performance (RDa.6): Cont. cruising speed, 235 kt (270 m.p.h.) at 20,000ft and 35,000 lb; corres. fuel consumption, 0.186 n.m./lb; $V_1 = V_2$ field length, max. take-off weight, zero wind, S.L., I.S.A., 4,800ft; at I.S.A. + 15 deg C, 5,140ft; at 5,000ft, I.S.A., 5,300ft at 35,000 lb; landing distance from 50ft at max. landing weight, S.L., 3,560ft; range A, 780 n.m. (900 st.m.); range B, 1,500 n.m. (1,725 st.m.); corres. payload, 4,700 lb; corres. cruise speed, 242 kt (278 m.p.h.).

GRUMMAN AIRCRAFT ENGINEERING CORP. *Bethpage, Long Island, New York, U.S.A.*

Grumman Amphibians The Grumman G-21 **Goose** six-seater airline and executive amphibian first flew in June, 1937, powered by two 450 h.p. Pratt & Whitney R-985 Wasp Juniors, and a total of 345 were built, many for the U.S.A.A.F., U.S. Navy and Coast Guard. There are 39 still in service with 12 operators, mostly in Alaska, Canada and the Caribbean. The Goose was followed by the smaller, five-seater G-44 **Widgeon** (first flown in July, 1940, and powered by two 200 h.p. Ranger 6-440-C5 engines. About half a dozen of the 286 Widgeons built remain in airline service. The G-73 **Mallard**, first flown in 1946, is rather larger than the Goose or Widgeon; it seats up to 10 passengers and is powered by two 600 b.h.p. Pratt & Whitney R-1340-S3H-1 Wasps. Only two of the 61 Mallards built are in airline service, with Pacific Western Airlines. The SA-16A-GR **Albatross**, although very similar externally to the Mallard, is much larger, having over twice the gross weight and engine power and a 13ft 4in greater wing span. Albatross production (over 300 have been built) has been entirely for military use, but three ex-U.S.A.F. SA-16As are used by Transocean Airlines.

The following figures apply to the G-21 **Goose:**

Powerplants: Two 450 b.h.p. (max. take-off) Pratt & Whitney R-985 Wasp Juniors.

Dimensions: Span, 49ft; length, 38ft 4in; height, 15ft; wing area, 375 sq ft.

Weights: Loaded, 8,000 lb; disposable load, 2,575 lb; empty, 5,425 lb.

Performance: Cruising speed, 191 m.p.h. at 5,000ft; max. range, 640 miles.

G-159 Gulfstream The twin-Dart Gulfstream is Grumman's contender for the American "heavy twin" executive market, at present served largely by Lodestars and DC-3s. The prototype made its first flight on August 14, 1958, and the company has now received orders for some 40 aircraft. Up to 12 passengers can be accommodated, or 19 in a high-density layout. Current basic price is about $1m.

Flight reference: April 3, 1959.

Powerplant: Two Rolls-Royce RDa.7/2 Dart 529 turboprops of 2,105 e.h.p. each driving 11ft 6in diameter Rotol four-bladed propellers.

Dimensions: Span, 78ft 4in; length, 63ft 8in; height, 22ft 9in; wing area, 615 sq ft; aspect ratio, 10.

Weights: Max. take-off, 33,600 lb; landing, 32,000 lb; zero fuel, 24,670 lb; capacity payload, 4,000 lb; weight less fuel and payload, 21,909 lb.

Payload accommodation: Cabin volume, 1,040 cu ft; baggage and freight volume, 100 cu ft; cabin length, 33ft; max. width, 7ft 4in; max. height, 6ft 1in; usable floor area, 177 sq ft; max. seats, 19.

Fuel capacity: 1,230 Imp. gal, and 600 lb water-methanol.

Performance: Cont. cruising speed, 304 kt (349 m.p.h.) at 25,000ft and 28,000 lb, with a fuel consumption of 1,400 lb/hr, balanced field length, max. take-off weight, sea level, I.S.A., 4,350ft; sea level, I.S.A. + 15 deg C, 4,650ft; at 5,000ft, I.S.A., 5,510ft; landing distance from 50ft, 2,780ft; range B (max. fuel), 1,960 n.m. (2,250 st.m.) at 303 kt (349 m.p.h.).

HAMBURGER FLUGZEUGBAU *Postschliessfach 11 524, Hamburg-Finkenwerder, Kreetslag 10.*

H.F.B.209 A projected development of the Eland-powered CASA 209 (see page 587). Described in *Flight*, July 19, 1957, page 93, it is believed that the project has been shelved. The company has since been studying other civil transport designs, including:—

H.F.B.314 This is an 80-seat short-range jet project, presumably in

Handley Page Dart Herald for B.E.A. (Rolls-Royce Dart turboprops)

the D.H.121/DC-9/Boeing 727 class, powered by two turbojets. The West German Government is reported to have been advised by Lufthansa that the project is worthy of government backing.

HANDLEY PAGE *Cricklewood, London, N.W.2.*

H.P.81 Hermes 4 Developed from the H.P.68 Hermes 1 prototype of 1945, through the experimental Hermes 2, the Hermes 4 was the first British four-engined airliner of post-war design to enter service with B.O.A.C. It was used extensively on the Corporation's African routes from March 1950, and a total of 25 were built, all for B.O.A.C. This fleet was sold to various British independents, and a total of 15 are now operated by Airwork, Britavia, Falcon and Skyways. Skyways' Hermes operate the London - Singapore freight service under charter to B.O.A.C. Airwork's two Hermes are up for sale at £10,000 each.

Powerplant: Four Bristol Hercules 763 of 2,100 b.h.p. each driving 13ft de Havilland four-bladed propellers.

Dimensions: Span, 113ft; length, 96ft 10in; height, 30ft; gross wing area, 1,408 sq ft.

Weights: Max. take-off, 86,000 lb; landing, 75,000 lb; capacity payload, 17,000 lb; empty, 51,655 lb.

Payload accommodation: Baggage and freight volume, 452 cu ft; cabin length, 44ft 5in; max. width, 10ft 3in; max. seats, 74.

Fuel capacity: 3,206 Imp. gal.

Performance: Max. weak mixture cruising speed, 232 kt (266 m.p.h.) at 20,000ft; take-off distance to 50ft, 4,086ft; landing distance from 50ft, 3,375ft; payload for max. range, 6,349 lb; a 14,400 lb payload can be carried 1,740 n.m. (2,000 st.m.) at 240 kt (276 m.p.h.) at 20,000ft.

Marathon 1 and 1A Designed by Miles Aircraft to the Brabazon Committee Type VA specification, the Marathon prototype made its first flight on May 19, 1946, and production was undertaken by Handley Page (Reading) Ltd., which took over Miles Aircraft in June, 1948. A total of 40 Marathons were built, of which 29 were operated by the R.A.F. as navigational trainers. First commercial operator of Marathons was West African Airways Corporation, followed by Union of Burma Airways and Far East Airlines (now part of All Nippon Airways). The two Japanese Marathons have now been grounded, and Derby Aviation Ltd., with three aircraft, is the only operator of this type.

Powerplant: Four D.H. Gipsy Queen 70 Mk 3 (Marathon 1) or 70 Mk 4 (Marathon 1A) engines of 340 b.h.p. each driving 7ft 6in de Havilland Hydromatic three-bladed propellers.

Dimensions: Span, 65ft; length, 52ft 1½in; height, 14ft 1in; wing area, 498 sq ft.

Weights: Max. take-off, 18,250 lb; capacity payload, 5,036 lb; basic equipped weight (18-passenger version), 12,244 lb.

Payload accommodation: Cabin volume, 760 cu ft; baggage and freight volume, 250 cu ft; cabin length, 18ft; max. width, 7ft 9in; mean height, 6ft 2in; dimensions of largest door, 62in × 30in; max. seats, 22.

Fuel capacity: 220 Imp. gal (standard) or 280 Imp. gal (long range).

Performance: Max. weak mixture cruising speed, 175 kt (201 m.p.h.) at 10,000ft at 18,000 lb; take-off distance to 50ft, 2,760ft; landing distance from 50ft, 2,370ft; a payload of 4,172 lb can be carried 626 n.m. (720 st.m.) at 137 kt (158 m.p.h.) at 5,000ft.

H.P.R.3 Dart Herald Designed as a private-venture replacement for the DC-3, the Herald prototype, powered by four 825 b.h.p. (max. take-off) Alvis Leonides Major 701 piston engines, made its first flight on August 25, 1955; the second prototype took to the air just over a year later. Increasingly wide acceptance of the Rolls-Royce Dart led to the piston-engined version eventually being abandoned in favour of the Dart Herald, announced in May, 1957.

The first prototype Herald was re-engined with two Darts and made its first flight in this form on March 11, 1958, and the second prototype has been similarly re-engined. The latter has already undertaken demonstration tours to Greece, Turkey, Persia, Pakistan, India and Ceylon as well as to Central and South America this year, and was recently demonstrated in Australia, New Zealand and the Far East.

First operator will be B.E.A., who will use three Dart Heralds purchased by the Government at a cost of some £750,000, including spares and crew training. These will be operated for an initial five-year period over certain Scottish routes where the aerodromes are too small for Viscounts, and will be delivered next summer. If found satisfactory by B.E.A., the Corporation has agreed to buy these Dart Heralds from the Government at the end of a five-year period. The Dart Herald's basic price is about £185,000.

Development has already commenced with an increase of 2,000 lb, to 39,000 lb, of the certificated gross weight of production aircraft. Looking further ahead, installation of more powerful RDa.10 Darts would allow a weight increase to 44,000 lb (civil) or 46,500 lb (military).

References: *Flight*, April 10, 1959; March 27, 1959; July 27, 1958; May 2, 1958. Operator's drawing, page 603.

Powerplants: Two Rolls-Royce RDa.7/2 Dart 527 turboprops of 2,100 e.h.p. each driving 12ft 6in Rotol four-bladed propellers.

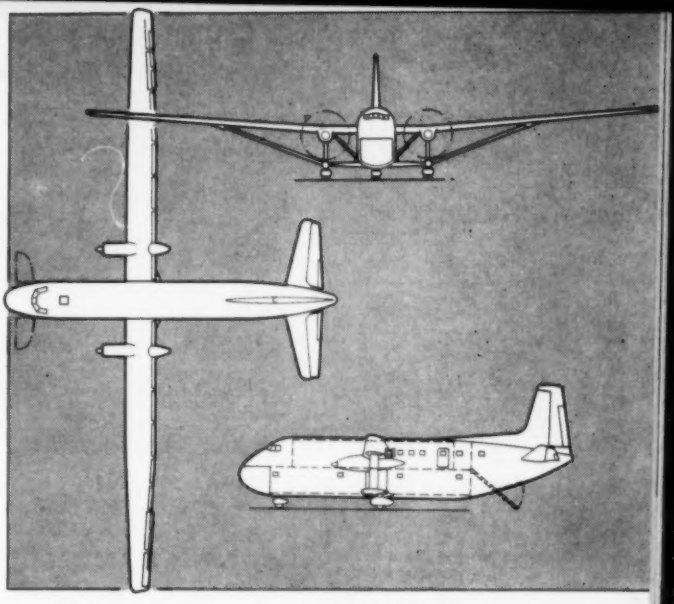
Dimensions: Span, 94ft 9in; length, 71ft 11in; height, 23ft 4in; wing area, 886 sq ft.

Weights: Max. take-off, 39,000 lb; max. landing, 38,500 lb; zero fuel, 36,000 lb; capacity payload, 13,300 lb (freighter) or 10,160 lb (38-passenger version); basic operational, 24,220 lb.

Payload accommodation: Cabin volume, 2,198 cu ft; cabin length, 48ft 9in; max. width, 8ft 8in; max. height, 6ft 5in; usable floor area, 260 sq ft; dimensions of largest entrance, 64in × 65in; max. seats, 47.

Fuel capacity: 1,080 Imp. gal plus 53 Imp. gal water-methanol.

Performance: Cont. cruising speed, 237 kt (272 m.p.h.) at 20,000ft and 36,500 lb, with a fuel consumption of 184 Imp. gal/hr; balanced field length at max. take-off weight, sea level, I.S.A., 4,100ft; at sea level, I.S.A.+15 deg C, 4,700ft; at 5,000ft, I.S.A. and 36,850 lb, 5,700ft; landing distance (SR422A, 60 per cent factor, max. landing weight), 3,540ft; range A (max. payload), 750 n.m. (862 st.m.) with 38 passengers; range B (max. fuel), 1,500 n.m. (1,725 st.m.) with 6,140 lb payload at 266 kt (306 m.p.h.) at 23,000ft.



Hurel-Dubois HD-37 car-ferry project (Wright Cyclone C9HE)

HEINKEL *Ernst Heinkel Flugzeubau G.m.b.H., Am neuen Reinhafen 10, Speyer a/Rhein, Germany.*

He.211 Reportedly a twin turboprop, 23-seat transport in the DC-3 replacement category, with STOL capabilities. Like the H.F.B.314 (page 608, col. 2) it is reported to have been recommended by Lufthansa to the West German government as worthy of backing.

HUNTING AIRCRAFT *Luton Airport, Bedfordshire, England.*

President Among the rôles for which the President—primarily intended for the executive market—is offered is that of a feeder-liner with up to 12 seats or as a light freighter. The design is supported by substantial sales to the R.A.F. and overseas air forces of the military version, the Pembroke.

Powerplant: Two Alvis Leonides 504/5A supercharged piston engines of 540/560 b.h.p. each.

Dimensions: Span, 64ft 6in; length, 46ft; height, 16ft; wing area, 400 sq ft.

Weights: Take-off, 13,500 lb; capacity payload, 2,244 lb; weight less fuel and payload, 7,937 lb.

Payload accommodation: Cabin volume (less flight deck) 449 cu ft; baggage and freight volume, 50 cu ft; cabin length, 20ft; max. height, 6ft; max. width, 5ft 6in; dimensions of largest door, 62in × 50in.

Fuel capacity: 238 Imp. gal, or 388 Imp. gal with extra tanks.

Performance: Cont. cruise speed, 162 kt (187 m.p.h.) at 4,000ft and 13,500 lb; corres. fuel consumption 1.83 n.m./gal; balanced field length, 3,750ft; landing distance from 50ft, 2,560ft; range A (max. payload), 620 n.m. (714 st.m.); range B, 710 n.m. (817 st.m.), each range with I.F.R. fuel allowances.

H-107 The existence of Hunting's short-range jet project has been known for about 18 months and in September last year a registration (G-APOH) appeared under the designation H-107 in the British Register of Civil Aircraft. A mock-up has been built.

Powerplant: Two Bristol Siddeley B.E.61 turbofans of 7,000 lb static thrust each with provision for silencers and reversers.

Dimensions: Span, 80ft; length, 85ft 2in; height, 24ft; wing area, 800 sq ft.

Weights: Take-off, 42,400 lb; max. landing, 40,500 lb; zero fuel, 34,700 lb; weight less fuel and payload 22,530 lb; max. payload, 12,000 lb.

Payload accommodation: Cabin volume, 2,500 cu ft; baggage and freight volume, 353 cu ft; cabin length, 49ft; max. width, 8ft 6in; max. height, 6ft 2½in; max. usable floor area, 415 sq ft; dimensions of largest door, 66in × 33in; seats, 48-56.

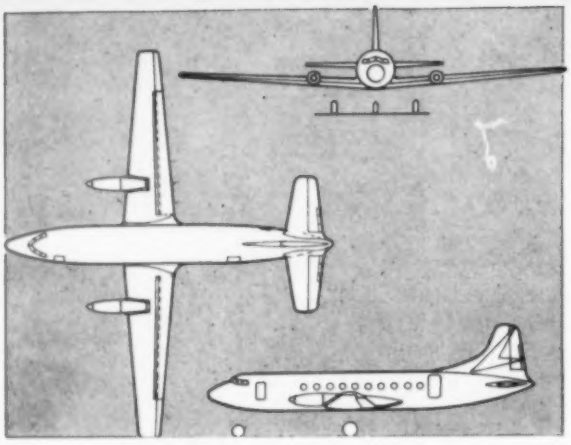
Fuel capacity: 2,230 Imp. gal.

Performance: Cruise speed 440 kt (505 m.p.h.) at 30,000ft and 38,000 lb; corres. fuel consumption, 415 Imp. gal/hr; balanced field length, I.S.A., sea level, 3,750ft, I.S.A.+15 deg C, 4,200ft, I.S.A., 5,000ft, 4,950ft; landing distance from 50ft, 2,600ft; range A (max. payload), 1,000 n.m. (1,150 st.m.) at 400 kt (460 m.p.h.); range B (max. fuel), 2,200 n.m. (2,520 st.m.) with 2,240 lb payload at 440 kt (505 m.p.h.) at 30,000ft.

D.H.121 Hunting is a partner in the Airco D.H.121. See page 578.

HUREL-DUBOIS *Société de Constructions des Avions Hurel-Dubois, Boite Postale No. 6, Meudon, France.*

HD-321 The remarkable Hurel high aspect-ratio strutted wing was



Japan Air Transport YS-11 (Rolls-Royce Dart RDa.10)

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

developed to provide great lifting capacity (through a high L/D ratio) for low weight and cost. The first Hurel-Dubois transport prototype was the HD-31, which made its first flight on January 27, 1953; a developed and more powerful version, the HD-32, flew in prototype form on December 29 the same year, and a second prototype followed in February 1954. Later, both HD-32 prototypes were re-engined with Wright Cyclones as replacements for the Pratt & Whitney Twin Wasps fitted earlier, and the first flight in this HD-321 configuration was made on December 22, 1955. No airline orders were received, but six derivatives—HD-34s—are being delivered to the Institut Geographique National. *Flight* reference: September 20, 1957, p. 479.

Powerplant: Two Wright 982C9HE1 piston engines of 1,475 b.h.p. each driving Hamilton 12ft 6in propellers.

Dimensions: Span, 148ft 2in; length, 76ft 4in; height empty, 27ft 6in; wing area, 1,076 sq ft; aspect ratio, 20.2.

Weight: Take-off, 41,890 lb; landing, 41,890 lb; zero fuel, 41,890 lb; capacity payload, 14,000 lb; weight less fuel and payload, 24,498 lb.

Payload accommodation: Cabin volume, 2,115 cu ft; baggage and freight volume, 1,450 cu ft; cabin length, 43ft 11in; max. width 7ft 2½in; max. height, 7ft 2in; max. usable floor area (less flight deck), 207 sq ft; dimensions of largest door, 6ft 7in × 5ft 11in; max. seats, 48.

Fuel capacity: 790 Imp. gal (950 U.S. gal).

Performance: Cont. cruise speed, 149 kt (172 m.p.h.) at 10,000ft and 41,150 lb; corres. specific fuel consumption, 480 lb/b.h.p./hr; balanced field length, not stated; landing distance from 50ft, 1,870ft; range A, 134 n.m. (155 st.m.); range B, 1,150 n.m. (1,325 st.m.); corres. payload, 11,020 lb; corres. cruise speed, 149 kt (172 m.p.h.).

HD-37 At the Paris Show in June 1959 was shown a model of a double-decker Hurel-Dubois with fuselage accommodation for five cars and 28 passengers. HD-34 wings and struts were used and Bristol Hercules engines. Rolls-Royce Dart 527s could be fitted. It was reported that the design had been offered to Silver City, but it now seems clear (see Bristol-Bréguet) that this particular market is filled.

ILYUSHIN Sergei Vladimirovich Ilyushin has been responsible for an important series of bombers and transports represented, in post-war years, by the Il-28 jet bomber, the Il-12 and Il-14 piston-engined transports, and the Il-18 Moskva turboprop airliner. All these types (including a mail-carrying version of the Il-28) have been, or are being, used by Aeroflot.

Il-12 Dating from 1944, this is an unpressurized general-purpose transport with nosewheel undercarriage.

Powerplant: Two ASh-82T piston engines.

Dimensions: Span, 104ft; length, 69ft 11in.

Weights: Take-off, 38,000 lb; empty, 24,500 lb.

Performance: Cruising speed, 188 kt (217 m.p.h.) at 8,200ft.

Il-14 A development of the Il-12, manufactured in two variants: Il-14P, the standard version, seating 18 or 26 passengers; and Il-14M, having a lengthened cabin, seating 24 or 28. Both variants have been licensed to East Germany and Czechoslovakia.

Powerplant: Two ASh-82FNV piston engines, driving four-blade, constant-speed propellers.

Dimensions: Span, 104ft; length (Il-14P), 69ft 11in; length (Il-14M), 73ft 4in.

Weights: Take-off (Il-14P), 36,400 lb; empty, 26,600 lb; take-off (Il-14M), 38,000 lb; empty, 27,000 lb.

Performance: Cruising speed (Il-14P), 173-188 kt (200-217 m.p.h.); cruising speed (Il-14M), 173-191 kt (200-220 m.p.h.); take-off run (Il-14P), 1,540ft; take-off run (Il-14M), 1,476ft; range (Il-14P), 1,150 miles approx.; range (Il-14M), 950 miles approx.

Il-18 Moskva Now having several months of Aeroflot service behind it, the Il-18 has established itself as an efficient and competitive example of the modern turboprop airliner. The first example was flown in 1957 and the type went into service in April this year. It is also used by the Soviet Air Force. An appraisal of the aircraft following an inspection by a member of *Flight's* staff was printed in our issue of September 4, 1959. Early Il-18s had as alternative powerplants four 4,000 h.p. turboprops by Kuznetsov (NK-4) or Ivchenko (AI-20). The Ivchenko unit is now standard. On the aircraft inspected there was a well-appointed 15-seat cabin forward and immediately aft was a long section housing coat-hanging space and galley. Rearwards again was the main cabin, with 13 rows of five-abreast seats. Oxygen does not appear to be supplied to each seat, but there are several large cylinders of it in racks next to the sliding main entrance at the rear. Opposite is a couch, understood to be for passengers who feel ill. There is additional coat-hanging space in this area and two large and well-equipped wash-rooms and toilets, which include rest seats, electric-razor points and large mirrors. In the cockpit normal air-conditioning is supplemented by two fans. The crew numbers four.

Powerplant: Four Ivchenko AI-20 turboprops of 4,000 e.s.h.p. driving 13ft 9in four-blade reverse-pitch propellers.

Dimensions: Span, 122ft 8in; length, 117ft; height, 33ft 5in; wing area, 1,500 sq ft approx.

Weights: Take-off, 112,200-140,600 lb; max. payload, 30,800 lb.

Payload accommodation: Seating for 75-100 passengers.

Fuel capacity: About 6,000 Imp. gal.

Performance: Cruising speed, up to 354 kt (407 m.p.h.) at 24,300ft, with a max. range of 3,120 miles plus one hour's reserve; take-off distance, 2,500-3,000ft; landing distance, 1,700-2,000ft.

JAPAN AIR TRANSPORT *Yusoki Sekkei Kenkyu Kyokai, Sugita, Yokohama, Japan.*

YS-11 This twin-Dart design is the final project of a series of studies by a Japanese design committee headed by Dr. Hidemasa Kimura of the Y.S.K.K. (Transport Aircraft Designing Research Association) set up in April 1957. Basic design was completed by January of this year and a full-scale mock-up has been built at the Sugita factory.

Financing of the YS-11 will be a joint effort between the Japanese government (contributing about £2.5m) and a consortium of private interests known as the Nippon Ryokakuki Seizo Kaisha (Japan Air Transport Manufacturing Company). Participants will be: Mitsubishi Heavy Industries, Kawasaki Aircraft, Fuji Heavy Industries, Nippon Hikoki, Shin Meiwa Kogyo, and Showa Hikoki. Their investment averages £12,500 apiece.

The aircraft itself is to have the most-developed Rolls-Royce Darts (RDa.10s) and a fuselage diameter of over 10ft to accommodate 60-70 passengers. The designers estimate a demand for about 150 aircraft between 1960-1966, including about 40 for export. Several variants are projected, among them the **YS-31** (two RDa.7s), the **YS-12** (two RDa.10s) and **YS-12-4** (four RDa.10s). *Flight* references: May 23, 1958; February 13, 1959; and August 21, 1959.

Powerplant: Two Rolls-Royce Dart RDa.10 turboprops of 2,660 e.h.p. for take-off driving 14ft Rotol propellers.

Dimensions: Span, 105ft; length, 86ft 11in; height, 29ft 2in; wing area, 1,022 sq ft.

Weights: Max. take-off, 49,600 lb; payload, 11,900 lb.

Payload accommodation: Baggage and freight volume, 286 cu ft; cabin length, 57ft 6in; max. width, 10ft 9in; max. height, 7ft; max. seats, 65.

Fuel capacity: Approx. 800 Imp. gal (960 U.S. gal).

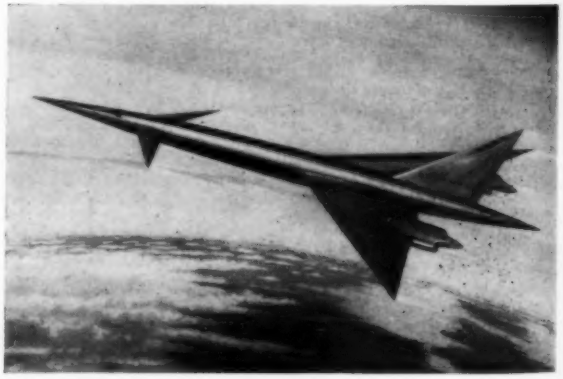
Performance: Cont. cruising speed, 265 kt (305 m.p.h.) at 20,000ft, I.S.A.; take-off (I.C.A.O. definition), sea level, I.S.A., 3,930ft; range A (max. payload), 910 n.m. (1,040 st.m.).

LOCKHEED AIRCRAFT CORPORATION *Burbank, California, U.S.A.*

L.10 Design work began on the all-metal L.10 Electra, a twin-engined eight to ten-passenger monoplane, in 1932. It was obviously inspired by the success of the first two "modern-type" transports, the Boeing 247 and Douglas DC-1 but, being smaller, it was not directly competitive. The Electra's first flight was on February 23, 1934, and the type went into service with North West Airways soon afterwards. It was later supplied to Pan American, Eastern, Braniff, Delta and others. A total of 148 were built and 20 remain in service today with eleven operators.

The Electra, in successively improved versions, remained in production

Lockheed's conception of a Mach 3.0-3.5 supersonic transport



Lockheed Electra (Allison 501-D13)

for five years and was succeeded by the L.12, L.14 and L.18 which were built in considerable numbers before and during the War. A few of each of these types also remain in airline service today.

Powerplant: Two 450 h.p. Pratt & Whitney R-985-13s driving Hamilton Standard 9ft propellers.

Dimensions: Span, 55ft; length, 38ft 7in; height, empty, 10ft 1in; wing area, 458 sq ft.

Weights: Max. take-off, 10,500 lb; landing, 10,500 lb; zero fuel, no restriction; capacity payload, 2,400 lb; weight less fuel and payload, 7,000 lb.

Payload accommodation: Baggage and freight volume, 68 cu ft; cabin length, 15ft 10in; max. width, 4ft 7in; max. height, 5ft; dimensions of largest door, 3ft 8in × 2ft; max. seats, 10.

Fuel capacity: 169 Imp. gal (203 U.S. gal).

Performance: Cont. cruising speed, 157 kt (180 m.p.h.) at 9,600ft and 10,000 lb; corres. fuel consumption, 42 Imp. gal/hr; range B (max. fuel), 620 n.m. (713 st.m.); corres. payload, 2,300 lb; corres. cruise speed, 157 kt (180 m.p.h.).

L.049 In 1940 Lockheed were persuaded by T.W.A. (who placed an initial order for nine aircraft) to enter the long-haul business in competition with Boeing and Douglas who had also committed themselves to large four-engined aircraft in this category. The result of discussions in the summer of 1939, the Constellation owed something of its general layout to a four-engined, short-haul project, the L.44 Excalibur, but was much larger, being designed to carry 40 passengers across North America non-stop. The first flight was made on January 9, 1943, and 73 of a military version were ordered by the U.S. Army Air Force. It went into limited use in mid-1944. But the Constellation did not reach airline service until after the War—with T.W.A. in February 1946. Thereafter, it established itself as the leading long-haul transport of the period and was ordered by many operators, a total of 88 being built of the first version—all of which had originally been ordered as military aircraft. Some 54 of these are still in service with seven airlines. The L.049 at first cost about $700,000 (£170,000) but later this was increased to about $800,000 (£200,000). Passengers are accommodated four-abreast in the more luxurious layouts and five-abreast in high density configurations.

Powerplant: Four 2,200 h.p. Wright R-3350-C18-BA-3s driving Hamilton Standard Hydromatic 33E60-41/6801A 15ft 2in propellers.

Dimensions: Span, 123ft; length, 95ft 2in; height empty, 22ft 5in; wing area, 1,650 sq ft.

Weights: Max. take-off, 98,000 lb; landing, 83,000 lb; zero fuel, 81,464 lb; capacity payload, 18,423 lb; weight less fuel and payload, 60,367 lb.

Payload accommodation: Cabin volume, 3,000 cu ft; baggage and freight volume; 434 cu ft; cabin length, 64ft 9in; max. width, 10ft 8.6in; max. height, 6ft 6in; max. usable floor area, 561 sq ft; dimensions of largest door, 2ft 3in × 6ft; max. seats, 81.

Fuel capacity: 3,970 Imp. gal (4,770 U.S. gal).

Performance: Cont. cruising speed, 272 kt (313 m.p.h.) at 20,000ft and 83,000 lb; corres. consumption, 370 Imp. gal/hr; balanced field length, 4,800ft; at S.L., I.S.A.+15 deg C, 5,016ft; at 5,000ft, I.S.A., 5,710ft; landing distance from 50ft, 4,050ft; range A (max. payload), 1,970 n.m. (2,260 st.m.); range B (max. fuel), 3,470 n.m. (4,000 st.m.); corres. payload, 10,283 lb; corres. cruise speed, 235 kt (270 m.p.h.).

L.749 In 1946 Lockheed produced the first purely civil version of the Constellation. This was the L.649 which had improved accommodation standards and was known as the "Gold Plate" Constellation. It flew for the first time on October 19, 1946, and went into service with Eastern Air Lines in May 1947. The L.749 followed the 649. It was similar but had more fuel tankage for long-haul overwater operations. The first were delivered later in 1947 and many 649s were later converted to 749 standard. The 749A is the same basic aircraft but is cleared to operate at higher weights. A total of 133 L.649, 749 and 749As were built (plus twelve of a military version) and 127 are still in service with 16 airlines. Current market price (L.749A): £112,250.

Powerplant: Four 2,500 h.p. Wright R-3350-C18-BD1s driving Hamilton Standard Hydromatic 43E60/6801A 15ft 2in propellers.

Dimensions: As L.049.

Weights: Max. take-off, 107,000 lb; landing, 89,500 lb; zero fuel, 86,464 lb; capacity payload, 20,276 lb; weight less fuel and payload, 65,074 lb.

Payload accommodation: As L.049.

Fuel capacity: 4,920 Imp. gal (5,910 U.S. gal).

Performance: Cont. cruising speed, 264 kt (304 m.p.h.) at 20,000ft and 104,000 lb; corres. fuel consumption, 385 Imp. gal/hr; balanced field length, 4,850ft; at S.L., I.S.A.+15 deg C, 5,100ft; at 5,000ft, I.S.A., 6,920ft; landing distance from 50ft, 4,670ft; range A (max. payload) 3,300 n.m. (3,800 st.m.); range B (max. fuel), 4,210 n.m. (4,840 st.m.); corres. payload, 8,026 lb; corres. cruising speed, 230 kt (264 m.p.h.).

L.1049C Lockheed did not stretch the fuselage of the Constellation until more than a year after their competitors at Douglas had produced tne DC-6A—in effect, the second "pull-out" of the original DC-4. The prototype Super Constellation flew for the first time on October 13, 1950. It had a fuselage 18ft longer, a max. take-off weight raised to 120,000lb and was powered by up-rated engines of 2,700 h.p. giving a total increase of 800 h.p. The original production Super Constellations were the L.1049s delivered to Eastern Air Lines and were put into service in November 1951; a total of 24 were built for Eastern and T.W.A. Although the economics were good, the aircraft proved under-powered and it did not sell to any other operator. However, Lockheed received an order from the U.S. Navy for a developed version of the Super Constellation to be powered with the new Wright Turbo-Cyclone compound engine of 3,250 h.p. This aircraft was provided with a new wing which was structually a considerable advance on its predecessor. It was much stronger, permitting a marked additional increase in operating weights. The civil version of the naval Super Constellation was known as the L.1049C and was ordered by T.W.A. in 1950. It flew for the first time on February 17, 1953, and entered service in the following June, giving T.W.A. an immediate advantage on the transcontinental routes. It was subsequently ordered by several other operators and was followed in production by the improved D and E versions. A total of 102 L.1049/L.1049E were built (plus about 320 equivalent military models) and 87 are still in service with twelve airlines. Current used asking price is about £357,000.

L.1049G The success of the 1049C, which had been the first civil aircraft with the Wright Turbo-Cyclone compound engine, encouraged Lockheed to produce a series of further developments. The last and most important were the 1049G and H. The "Super G," as it is widely known, first flew on December 7, 1954, and entered service in January 1955 with Northwest Airlines. A total of 130 were subsequently built and 101 are still in service with 16 airlines. The 1049G is primarily a long-haul aircraft and, for maximum range, is fitted with wing tip fuel tanks. The 1049H is a freighter version of which 54 were built; 50 are still in service with 15 airlines. Current used asking price, £250,000.

Powerplant: Four 3,400 h.p. Wright R-3350-972-TC-18-DA-3, EA-3 or EA-6 compounds driving Hamilton Standard Hydromatic 43H60-305/6959B-0 15ft 2in propellers.

Dimensions: As L.049 except length, 113ft 7in; height empty, 24ft 9.4in.

Weights: Max. take-off, 137,500 lb; landing, 113,000 lb; zero fuel, 103,500 lb; capacity payload, 24,293 lb; weight less fuel and payload, 79,237 lb.

Payload accommodation: Cabin volume, 4,800 cu ft; baggage and freight volume, 694 cu ft; cabin length, 83ft 2in; max. width, 10ft 8.6in; max. height, 6ft 6in; max. usable floor area, 744 sq ft; dimensions of largest door, 2ft 3in × 6ft; max. seats, 99.

Fuel capacity: 6,550 Imp. gal (with tip tanks), (7,870 U.S. gal).

Performance: Cont. cruising speed, 270 kt (310 m.p.h.) at 20,000 ft and 131,000 lb; corres. fuel consumption, 370 Imp. gal/hr; balanced field length, 5,800ft; at S.L., I.S.A. +15 deg C, 6,340ft; at 5,000ft, I.S.A., 7,800ft; landing distance from 50ft, 5,270ft; range A (max. payload), 3,620 n.m. (4,160 st.m.); range B (max. fuel), 4,185 n.m. (4810 st.m.); corres. payload, 18,315 lb; corres. cruise speed, 243 kt.

L.1649A Lockheed, in consultation with T.W.A., decided in 1954 to produce a final development of the Constellation series which would have a similar, or greater, range than the Douglas DC-7C. Lockheed's modification of the Constellation consisted of an entirely new wing of increased span and aspect ratio as well as a fuselage stretched a further 2ft 7in. The new aircraft, which was known as the L.1649A, flew for the first time on October 10, 1956, and went into service with T.W.A. (as the Jetstream) in May 1957. Although the new wing gave the 1649 even more range than the DC-7C, the extra design work and the later start proved a serious handicap and only 45 L.1649As were sold. There are 42 still in service with T.W.A., Lufthansa and Air France. The 1649A originally cost about $2,500,000 (£900,000) but this price was later reduced to $2,350,000 (£840,000). *Flight* reference: July 6, 1956.

Powerplant: Four 3,400 h.p. Wright R-3350TC-18-EA-2 compounds

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

Martin 4-0-4 (Pratt & Whitney Double Wasps)

driving three-blade Curtiss C.634S-C602 16ft 10in diameter propellers.

Dimensions: Span, 150ft; length, 116ft 1.6in; height empty, 23ft 4.8in; wing area, 1,850 sq ft; aspect ratio, 12.0

Weights: Max. take-off, 160,000 lb; landing, 123,000 lb; zero fuel, 116,000 lb; capacity payload, 23,000 lb; weight less fuel and payload, 91,806 lb.

Payload accommodation: Cabin volume, 4,875 cu ft; baggage and freight volume, 593 cu ft; cabin length, 86ft; max. width, 10ft 8.6in; max. height, 6ft 6in; max. usable floor area, 744 sq ft; dimensions of largest door, 2ft 3in × 6ft; max seats, 99.

Fuel capacity: 7,990 Imp. gal (9,600 U.S. gal).

Performance: Cont. cruising speed, 281 kt (323 m.p.h.) at 20,000ft and 123,000 lb; corres. consumption, 417 Imp. gal/hr; balanced field length, 6,250ft; at S.L., I.S.A. +15 deg C, 6,534ft; at 5,000ft, I.S.A., 8,280ft; landing distance from 50ft, 6,000ft; range A (max. payload), 4,700 n.m. (5,400 st.m.); range B (max. fuel), 5,460 n.m. (6,280 st.m.); corres. payload, 10,777 lb; corres. cruise speed, 222 kt (255 m.p.h.).

L.188 Electra The Electra was designed to meet a specification issued to the U.S. aircraft industry in January 1955 by American Airlines. The Lockheed project was chosen, and American ordered 35 in June 1955. The specification called for a transport with optimum economics over short and medium stages—a specification for what was loosely termed "a DC-6B replacement," and Lockheed's experience with the T56-powered C-130 of 1954 [see Lockheed GL-207], encouraged them in the choice of turboprop propulsion.

The first Electra flew on December 6, 1957, and flight tests culminated in F.A.A. certification on August 22, 1958. The first airline to take delivery, in October 1958, was Eastern, who inaugurated the first scheduled services between Miami and New York on January 12, 1959. American's first services were on January 23, 1959.

To date more than 100 Electras have been delivered to ten airlines and the order book (accounting for 175 aircraft for 16 airlines) is as follows: Eastern, 40 (current); American, 35 (current); Braniff, 9 (current); National, 23 (current); K.L.M., 12 (current); Western, 9 (current); Garuda, 3 (summer 1960); Pacific Southwest, 4 (current); Cathay Pacific, 2 (complete); Aeronaves de Mexico, 3 (1960); Qantas, 4 (imminent); Ansett-A.N.A., 2 (complete); T.A.A., 2 (complete); T.E.A.L., 3 (current); Northwest, 18 (current); Capital, 5 (May-June, 1960); General Motors, 1.

The L.188C has increased tankage and 116,000 lb max. weight (initial aircraft were certified at 113,000 lb). K.L.M. were the first recipients of the "C," which is now the standard aircraft.

Basic price: £818,000. *Flight* references: July 25, 1958; November 1, 1957; July 6, 1956. An operator's reference drawing appears on page 601.

Powerplant: Four Allison 501-D13 turboprops of 3,750 e.h.p. each, driving Aeroproducts or Hamilton Standard 13ft 6in propellers.

Dimensions: Span, 99ft; length, 104ft 6½in; height, 32ft 8in; wing area, 1,300 sq ft.

Weights: Max. take-off, 116,000 lb; landing, 95,650 lb; zero fuel, 86,000 lb; capacity payload, 26,400 lb; weight less fuel and payload, 59,600 lb.

Payload accommodation: Cabin volume, 4,812 cu ft; baggage and freight volume, 636 cu ft; cabin length, 76ft 5in; max. width, 10ft 8in; max. height, 7ft ½in; max. usable floor area, 707 sq ft; dimensions of largest door, 78in × 35in passenger, 42in × 52in hold; max. seats, 99 (six abreast).

Fuel capacity: 5,400 Imp. gal (6,490 U.S.).

Performance: Cont. cruise speed, 352 kt (405 m.p.h.) at 22,000ft and 85,500 lb; specific fuel consumption, 0.466; balanced field length, max. take-off, sea level, I.S.A., 5,050ft; I.S.A.+15 deg C, 6,700ft; 5,000ft, I.S.A., 7,800ft; landing distance from 50ft, 4,270ft; range B (max. fuel), 3,650 n.m. (4,200 st.m.); corres. payload, 12,900 lb; corres. cruise speed 330 kt (380 m.p.h.).

GL-207 Super Hercules Announced in April 1959, the Super Hercules is a development of the C-130A and the heavier, more powerful C-130B Hercules military transports, several hundred of which are in service with the U.S.A.F. As its name suggests the Super Hercules has increased capacity: for example, compared with the C-130B, length is increased by about 25ft, span by 12½ft, and usable volume by about 65 per cent. Weight is up from 135,000 lb to 235,000 lb. Most important change is in the powerplant, Allison 550-B7s (T-61) of 6,500 h.p. each, compared with Allison D501-D22s of 4,050 e.h.p. of the C-130B.

The Super Hercules has not yet been built, and provisional orders placed by Slick (six) and Pan American (12) in July 1959 were contingent upon U.S.A.F. backing by September 30, 1959. This was not forthcoming and funds for the T-61 (for which the Super Hercules is so far the sole application) are also in doubt. It is believed that Slick are now likely to purchase CL-44s. The Super Hercules would be built by Lockheed, Georgia, and deliveries could be made in 1962. Basic commercial price would be approximately £1.1m. Drawing: page 605.

Powerplant: Four Allison 550-B7 turboprops of 6,500 e.h.p. each, driving Aeroproducts four-bladed 17ft propellers.

Dimensions: Span, 145ft; length, 122ft 2in; height, 38ft; wing area, 2,041 sq ft.

Weights: Max. take-off, 235,000 lb; landing 182,500 lb; zero fuel, 171,000 lb; capacity payload, 76,240 lb; weight less fuel and payload, 93,860 lb.

Payload accommodation: Cabin volume, 7,026 cu ft; cabin length, 64ft 7in; max. width, 10ft 3in; max. height, 9ft 1in; max. usable floor area, 662 sq ft; dimensions of largest door, 120in × 109in; max. seats (hypothetical), 105.

Fuel capacity: 9,586 Imp. gal (11,500 U.S. gal).

Performance: Cont. cruise speed, 333 kt (383 m.p.h.) at 20,000ft and 205,000 lb; corres. fuel consumption, 795 Imp. gal/hr; balanced field length, max. take-off weight, sea level, I.S.A., 7,250ft; sea level+15 deg C, 9,800ft; 5,000ft, I.S.A., 1,050ft; landing distance from 50ft, 5,950ft; range A (max. payload), 3,564 n.m. (4,100 st.m.); range B (max. fuel), 4,814 n.m. (5,540 st.m.); corres. payload, 59,710 lb; corres. cruise speed, 324 kt (373 m.p.h.).

JetStar Designed to a U.S.A.F. specification for a ten-passenger light jet transport, the JetStar is now being produced as a very fast eight-seater executive type, against orders from a number of U.S. business corporations. In an exceptional effort to be first in the field, Lockheed designed and built the aircraft in the eight months prior to the first flight on September 4, 1957. Two prototypes are flying with two Bristol Siddeley Orpheus engines and in September one of these was delivered to Pratt & Whitney for conversion to four P. & W. JT-12-A6s. The heavier and more developed production aircraft will be thus powered and equipped with thrust reversers. The first should fly in December. Orders have been placed by Continental Can Co. (delivery January 1961), Canadian Department of Transport (delivery June 1961) and Ryder System Inc. *Flight* references: September 13, 1957; September 20, 1957; December 12, 1958; and August 21, 1959.

Powerplant: Four Pratt & Whitney JT-12-A6 of 3,000 lb st. thrust each.

Dimensions: Span, 53ft 8in; length, 60ft 6in; height, 20ft 6in.

Weights: Max. take-off, 38,930 lb; max. landing, 28,000 lb; max. payload, 2,439 lb.

Payload accommodation: Cabin volume, 716 cu ft; max. seats, 17.

Performance: Cont. cruising speed at 45,000ft and 25,000 lb, 445 kt (512 m.p.h.); balanced field length, I.S.A., sea level, 7,000ft; range A (max. payload), 2,530 n.m. (2,970 st.m.).

THE MARTIN COMPANY *Middle River, Baltimore 3, Maryland, U.S.A.*

Martin 2-0-2 First twin-engined airliner of completely post-war design to be approved by the C.A.A. for airline use, the Martin 2-0-2 prototype first flew on November 22, 1946. Like the Convair 240, it was aimed at the DC-3 replacement market, but a number of setbacks early in its career enabled the Convair 240 and its successors to capture most of the market, especially overseas. Unlike the Convair-liners, the Martin 2-0-2 is unpressurized. Only 31 were built, for Northwest Orient, L.A.N. (Chile), and L.A.V. (Venezuela); the last two airlines retain their 2-0-2s but those of Northwest have been disposed of.

Twelve more of an improved version, the Martin 2-0-2A, were supplied to T.W.A.; these are fitted with R-2800-CB16 Double Wasps like the Martin 4-0-4, and have a max. take-off weight of 43,000 lb and increased fuel tankage. T.W.A. has now withdrawn its 2-0-2As from service. L.A.N. and L.A.V., with four and two respectively, and Allegheny Airlines and Pacific Air Lines, with eight aircraft each, are the only operators of the Martin 2-0-2 series. Current secondhand market price being asked for 2-0-2s is £39,300.

Powerplant: Two Pratt & Whitney R-2800-CA18 Double Wasps of 2,400 b.h.p. each with water injection driving 13ft 1in Hamilton Standard three-bladed propellers.

Dimensions: Span, 93ft 3in; length, 71ft 4in; height, 28ft 5in; wing area, 864 sq ft.

Weights: Max. take-off, 39,900 lb; capacity payload, 9,270 lb; weight empty (equipped), 26,930 lb.

Payload accommodation: Baggage and freight volume, 281 cu ft; cabin length, 34ft 8in; minimum width, 9ft; max. height, 6ft 7in; max. seats, 40.

Fuel capacity: 1,010 U.S. gal.

Performance: Cruising speed, 249 kt (286 m.p.h.) at 12,000ft; take-off distance to 50ft, max. take-off weight, 1,565ft; landing distance from 50ft, 1,720ft at 38,000 lb weight; range, with allowances, 552 n.m. (635 st.m.) with 36 passengers and baggage plus 1,000 lb cargo; max. range, 1,760 n.m. (2,020 st.m.).

Martin 4-0-4 The Martin 4-0-4 is a development of the 2-0-2, from which it differs in being pressurized and having a 39in longer fuselage. C.A.A. type certification of the 4-0-4 was granted on October 5, 1951; the prototype, a modified Martin 2-0-2, had made its first flight on October 21, 1950. A total of 103 Martin 4-0-4s were built, 60 for Eastern, 41 for T.W.A. and two military versions, designated RM-1, for the U.S. Coast Guard. Most of Eastern's and T.W.A.'s are still in service, although reports indicate that T.W.A. has sold ten to a used aircraft dealer. Current secondhand market price: £112,500.

Powerplant: Two Pratt & Whitney R-2800-CB16 Double Wasps of

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

2,400 b.h.p. each with water injection, driving 13ft 1in Hamilton Standard three-bladed propellers.

Dimensions: As Martin 2-0-2, except length, 74ft 7in.

Weights: Max. take-off, 44,900 lb; max. landing, 43,000 lb; capacity payload, 11,592 lb; manufacturer's weight empty, 29,126 lb.

Payload accommodation: Baggage and freight volume, 316 cu ft; cabin length, 37ft 11in; min. width, 9ft; max. height, 6ft 5½in; forward door dimensions, 32in × 60in; max. seats, 40.

Fuel capacity: 1,350 U.S. gal (1,120 Imp. gal).

Performance: Cruising speed, 244 kt (280 m.p.h.) at 18,000ft and 38,000 lb, with 1,200 b.h.p. per engine; take-off distance to 50ft, max. take-off weight, 1,980ft; landing distance from 50ft at max. landing weight, 1,750ft; range, with allowances, 805 kt (925 st.m.) with 40 passengers and baggage plus 1,000 lb cargo; range with max. fuel, 2,200 n.m. (2,525 st.m.) at 10,000ft with 5,694 lb payload.

MAX HOLSTE *Société Nouvelle des Avions Max Holste, 11, Rue Gosset, Rheims, France.*

MH-1521 Broussard Powered by the 450 h.p. Pratt & Whitney R.985 engine, the Broussard is a light eight-passenger transport designed for duties similar to those of the D.H. Beaver. The first prototype flew on November 17, 1952 and the first production aircraft on June 16, 1954. About 50 orders have been met from civil operators but the bulk of production is for the French Services.

MH-250 Super Broussard Another light transport with both civil and military applications, the Super Broussard has about twice the capacity and more than twice the power of the Broussard and is described by its manufacturers as a *"camionette volante"* or a feeder liner for 17-23 passengers. It is powered by two Pratt & Whitney R.1340 piston engines of 600 h.p. each, and the first flight was made on May 20, 1959. This particular aeroplane is, in effect, an experimental prototype for the MH-260 Super Broussard powered by two Turboméca Bastan turboprops. A handling assessment appeared in last week's issue.

MH-260 Super Broussard The prototype MH-260 is now under construction. Apart from the powerplant it will be generally similar to the MH-250 but the fuselage will be about 6ft longer. It is understood that a production batch of 100 is to be underwritten by the French Government. A pre-production batch of five aircraft is being built by Nord and assembled by Max Holste and the first flight will be in March next year. By 1962 production should be four to five a month. The price, fully equipped, is £82,000. *Flight* references: March 27, 1959 and August 14, 1959.

Powerplant: Two Turboméca Bastans producing 957 b.h.p. each for take-off and driving Ratier propellers.

Dimensions: Span, 71ft 8in; length, 58ft 1in; height, 21ft; wing area, 592 sq ft.

Weights: Max. take-off, 21,165 lb; max. landing, 21,165 lb; zero fuel, 17,858 lb; payload, 7,496 lb; weight less fuel and payload, 11,095 lb.

Payload accommodation: Cabin volume, 1,183 cu ft; baggage volume, 109 cu ft; cabin length, 21ft 4in; max. width, 7ft 2in; max. height, 8ft 4in; max. floor area, 1,784 sq ft; dimensions of largest door, 65in × 56in; max. seats, 30.

Fuel capacity: 466 Imp. gal (560 U.S. gal).

Performance: Max. cont. cruise speed, 205 kt (235 m.p.h.) at 9,300ft and 18,000 lb; corres. fuel consumption, 108 gal/hr; accelerate-stop length, I.S.A., sea level, 2,191ft; landing distance from 50ft, 2,368ft; range A (max. payload), 275 n.m. (316 st.m.); range B (max. fuel), 755 n.m. (870 st.m.); corres. payload, 6,750 lb; corres. speed, 205 kt (235 m.p.h.).

MH-280 An alternative powerplant to the Bastan is the Lycoming T53 of similar power. The airframe is identical but the designation MH-280 has been adopted for this version.

F. G. MILES *Shoreham Airport, Shoreham-by-Sea, Sussex, England.*

HDM.106 Caravan This light transport project, now sheived, was the outcome of an Anglo-French technical partnership between Miles and Hurel Dubois formed in 1955. The two concerns formed a joint company to demonstrate the efficiency of the H.D. high aspect ratio wing formula when applied to a light transport. The immediate outcome was the now dismantled HDM.105, in effect an Aerovan test vehicle for the 20.5 A. R. wing. A handling description appeared in *Flight* for June 6, 1958.

The HDM.106, the developed production aeroplane, was to have two Lycomings of 290 b.h.p. or 340 b.h.p. A Turbo Caravan, HDM.106T, was also projected; this was to be powered by two 320 s.h.p. Turboméca Astazou turboprops. The HDM.106 was to have had a payload of 3,000 lb and accommodation for one car or 15 passengers. The idea behind it is being perpetuated in the Short S.C.7.

NORD AVIATION *Société Nationale de Constructions Aéronautiques du Nord, 12 bis Avenue Bosquet, Paris 7e, France.*

Nord 2502 Noratlas The Nord 2502 is a development of the Nord 2500 transport designed for the French Air Force, which was the basis for a series of variations. The prototype 2500 first flew on September 10, 1949, and French Air Force orders were subsequently placed for 200 of the production version. This was the 2501 powered by two Bristol Hercules 758s of 2,040 b.h.p. each. By 1951 a civil 45-seater (or cargo) version of the 2501 had also been designed and orders were placed by Empresa de Transportes Aerovias Brasil S.A., U.A.T. and by Israel.

The 2502 differs from its predecessor in that it is equipped with two Turboméca Maborés in wing-tip nacelles to improve take-off performance. U.A.T., who operate six 2502s, introduced the type into service on their African routes in 1954. Other operators are Arkia (two) and Air Algérie (two). The resale asking price of the 2502 is £210,000.

Other developments, not in quantity production, are: **Nord 2503** (Pratt & Whitney R-2800-CB17s); **Nord 2506** (as 2502 but with air-brakes, re-designed flaps and landing gear adjustable for height, now cancelled) and **Nord 2508** (as 2501 but with P. & W. R-2800-CB17s of 2,500 h.p. and two-stage supercharging). This variant was studied by Kalinga in December 1957, but orders have not so far been placed. *Flight* references: December 27, 1957 and February 26, 1959.

Powerplant: Two Bristol Hercules 758/759 of 2,040 b.h.p. each, built under licence by SNECMA, driving Rotol R.108 propellers, plus two Turboméca Maboré turbojets each of 880 lb static thrust.

Dimensions: Span, 110ft 3in; length, 72ft 0½in; height, empty, 19ft 10½in; wing area, 1,089 sq ft.

Weights: Max. take-off, 50,700 lb; max. landing, 48,500 lb; zero fuel, 46,720 lb; capacity payload, 16,640 lb; weight less fuel and payload, 30,080 lb.

Payload accommodation: Cabin, baggage or freight volume, 1,800 cu ft; cabin length, 32ft 4½in; max. width, 9ft; max. height, 6ft 7in; max. usable floor area, 233.6 sq ft; dimensions of largest door, 7ft 2½in; max. no of seats, 45.

Fuel capacity: 1,120 Imp. gal (1,345 U.S. gal).

Performance: Cont. cruise speed, 170 kt (195 m.p.h.) at 9,840ft and 50,000 lb; corres. fuel consumption, 0.244 st.m/lb; balanced field length, sea level, I.S.A., 2,085ft; at sea level, I.S.A.+15 deg C, 2,340ft; at 5,000ft, I.S.A., 2,565ft; landing distance from 50ft, 2,625ft; range A (max. payload), 686 n.m. (790 st.m.); range B (max. fuel), 1,480 n.m. (1,710 st.m.) corres. payload, 12,710 lb; corres. cruise speed, 161 kt (186 m.p.h.).

Transall C.160 Planned as a first co-operative venture between the French and German industries (although Nord 2501s have been built in Germany in quantity) is the Rolls-Royce Tyne-powered C.160 Transall project. Participants are Nord Aviation for France, and Hamburger-Flugzeugbau, Weser Flugzeugbau and Blume-Leichtbau and Flugtechnik for Germany. The project is a freighter with rear ramp-loading and an undercarriage retracting into twin pods on the fuselage. Gross weight will be 90,390 lb; span, 131ft and length 97ft 6in.

PEKING AERONAUTICAL INSTITUTE *Peking, Chinese People's Republic.*

Peking NR.1 First flown on September 4, 1958, the Peking NR.1 is believed to be the first aeroplane designed and built in Communist China. It appears to be similar in purpose to the Dove of 14 years ago; it carries eight passengers on rather more power—two 520 h.p. piston engines. A general arrangement drawing appeared in *Flight* of April 24, 1959, page 587. Span is approximately 57ft 10in and length 42ft 7in. Cruising speed is given as 300 km/hr (186 m.p.h.) and range as 1,072 km (670 st.m.). Cruising height is quoted as 4,800 metres (15,750ft). Very short field performance is claimed.

(POLAND) WARSAW AIRCRAFT DESIGN CENTRE *Warszawski Osrodek Konstrukiji Lotniczych, WSK-Okecie, Poland.*

MD-12 This Polish light transport was first shown publicly on September 6 this year, when it was flown by pilots of Poland's Aviation Institute. The design of Prof. Dr. Francisyek Misztal and Prof. Lesyek Duleba, the MD-12 is intended for use mainly as a passenger/cargo or all-cargo transport on short-haul domestic routes. Other versions cover ambulance, agricultural and survey duties, for which the short-field characteristics of the MD-12 are said to be suitable. The low wing has slotted ailerons.

Powerplant: Four Narkiewicz WN-3 air-cooled radial piston engines of 340 b.h.p. each.

Dimensions: Span, 69ft 11in; length, 51ft 10in; height, 19ft; wing area, 592 sq ft.

Weights: Max. take-off, 16,530 lb; payload, 3,860 lb; weight less fuel and payload, 10,912 lb.

Payload accommodation: Storage for 550 lb baggage; max. seats, 20.

Fuel capacity: 209 Imp. gal (250 U.S. gal).

Performance: Cruise speed, 154 kt (177 m.p.h.) at 8,200ft; take-off to 50ft with engine cut on take-off, 2,625ft; full-payload range (including 30 min reserve fuel), 378 n.m. (435 st.m.).

REPUBLIC *The Republic Aviation Corporation, Farmingdale, Long Island, N.Y., U.S.A.*

Rainbow A turboprop project under this name was offered to the airlines during 1957 and early 1958, but no orders were placed and the aircraft was not built. Slightly larger than the Viscount, and to be powered with Rolls-Royce Dart RDa.10s or General Electric T64s, the Rainbow was designed to carry a maximum payload of 19,200 lb over ranges of 2,000 m. It can be assumed that the project is now defunct.

Nord 2508 (P. & W. Double Wasps and Turboméca Maborés)

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

SAAB *Svenska Aeroplan Aktiebolaget, Linköping, Sweden.*

Scandia A-2 Although the Scandia first flew 13 years ago—on November 16, 1946—15 of the total of 18 that were built are still in service (with VASP). The aircraft was designed to meet the then-current I.C.A.O. and C.A.A. requirements for passenger transport aircraft and was intended to transport passengers over short and medium stages. The first order was placed by S.A.S. in 1948 and the Scandia was introduced into service in 1950.

Powerplant: Two Pratt & Whitney R-2180-E1 Twin Wasps of 1,650 b.h.p. driving 12ft 3in Hamilton Standard Hydromatic propellers.

Dimensions: Span, 91ft 10in; length, 69ft 11in; height, 23ft 3in; wing area, 922 sq ft.

Weights: Max. take-off, 36,380 lb; landing, 34,390 lb; zero fuel, 33,510 lb; weight less fuel and payload, 23,580 lb.

Payload accommodation: Cabin volume, 1,350 cu ft; baggage volume, 389 cu ft; cabin length, 32ft; max. width, 7ft 8½in; max. height, 5ft 11in; max. usable floor area, 215 sq ft; dimensions of largest door, 5ft 4½in × 2ft 3½in; max. seats, 32.

Fuel capacity: 638 Imp. gal (766 U.S. gal)+11 Imp. gal (13.7 U.S. gal) water.

Performance: Cont. cruise speed, 200 kt (230 m.p.h.) at 10,000ft and 33,150 lb; corres. fuel consumption, 0.28 st.m./lb; take-off to 50ft at sea level (both engines operating with water injection), 2,705ft; landing distance from 50ft, 1,870ft; range B (max. fuel), 1,214 n.m. (1,485 st.m.); corres. T.A.S., 156 kt (180 m.p.h.).

Twin-Dart Project Although no official announcement has been made by SAAB, it is believed that the company has for some while been actively studying a DC-3 replacement type powered by two Rolls-Royce Darts. This is understood to be a high-wing design.

SCOTTISH AVIATION *Prestwick Airport, Ayrshire, Scotland.*

Prestwick Pioneer Designed to Service requirements for very-short-field communications work, and first flown in 1947, the 4-passenger Pioneer was the precursor of the Twin Pioneer. It is powered by one Alvis Leonides 503/7 of 540 b.h.p., and 40 have been built for the R.A.F.

Twin Pioneer A 16-seat feeder liner with true STOL capacity, the Twin Pioneer is specifically intended for operations in remote areas of the world where available runway lengths are strictly limited. The prototype flew on June 25, 1955, and the first production aircraft followed rather less than a year later, on April 28, 1956. The latest version is the Series 3, in which 605 h.p. Alvis Leonides engines replace the 550 h.p. Leonides of the earlier series.

Five Twin Pioneers have been modified by Scottish at the request of Philippine Air Lines, and supplied with Pratt & Whitney R-1340 Wasps; little structural change was required. Another specialized variant of the Twin Pioneer has a 9ft increase in wingspan (Twin Pioneer outer wings are identical with those of the Pioneer) through the installation of pods on the wing tips carrying electro-magnetic equipment for geographical survey. An aircraft of this type has been supplied to the Rio Tinto Co.

Some 30 Twin Pioneers have now been manufactured for civil use and airline operators include de Kroonduif (2), Philippine Air Lines (5), Borneo Airways (2), British International Air Lines (2), Scottish Airlines (2), Fison-Airwork (3), Iraq Petroleum (1), and Iran Air Services (4). *Flight* descriptions: September 4, 1959; November 1, 1957; July 6, 1956; and September 30, 1955. Basic price: £63,000 less radio.

Powerplant: Two Alvis Leonides 531/8B piston engines of 605 b.h.p. driving de Havilland propellers.

Dimensions: Span, 76ft 6in; length, 45ft 3in; height, 12ft 3in; wing area, 670 sq ft.

Weights: Max. take-off, 14,600 lb; max. landing, 14,600 lb; capacity payload, 3,550 lb; weight less fuel and payload, 10,478 lb.

Payload accommodation: Cabin volume, 730 cu ft; baggage and freight volume, 65 cu ft; cabin length, 22ft 9in; max. width, 6ft; max. height, 5ft 10in; dimensions of largest door, 5ft 3in × 3ft 11in; max. seats, 16.

Performance: Cont. cruise speed, 114 kt (132 m.p.h.) at 5,000ft and 14,600 lb; corres. fuel consumption, 37.4 gal/hr; take-off field length (Group D) 1,500ft; ground run to unstick, 520ft; landing distance from 50ft, 1,240ft; range A (max. payload), 190 n.m. (220 st.m); range B (max. fuel), 680 n.m. (785 st.m.).

SHORT BROTHERS AND HARLAND *Queen's Island, Belfast, N. Ireland.*

S.25V Sandringham and S.45A Solent The Sandringham was a commercial adaptation of the Sunderland general reconnaissance flying boat, itself derived from the pre-war Empire boats. The Sandringham differed from the wartime "Hythes" (used by B.O.A.C.) chiefly in having Twin Wasps instead of Bristol Pegasus 38 or 48 radials and the nose and extreme rear fuselage were redesigned. Sandringhams—a total of 33 were converted from Sunderlands—were used after the war by B.O.A.C., Aviacion del Litoral Fluvial Argentino (a predecessor of Aerolineas Argentinas), Tasman Empire Airways and det Norske Luftfartselskap (D.N.L.). A dozen are still in airline service, six with Aerolineas Argentinas, three with C.A.U.S.A., two with Ansett-A.N.A. and one with T.A.I.

Saab Scandia (Pratt & Whitney Twin Wasps)

The Solent also is an airliner adaptation of a military flying boat, in this case the Seaford G.R.1, which was originally known as the Sunderland IV. The Solent features more powerful Bristol Hercules 637V or 733 radials and a higher gross weight. It has been used by B.O.A.C., Aquila Airways, Trans-Oceanic Airways and Tasman, but only one, owned by Tasman, now remains in airline service.

The following figures apply to the Sandringham 2:

Powerplants: Four Pratt and Whitney R-1830-92 Twin Wasps of 1,200 b.h.p. each for take-off, driving 12ft 1in Hamilton Standard Hydromatic propellers.

Dimensions: Span, 112ft 9¼in; length, 86ft 3in; height, 32ft 10¼in; wing area, 1,687 sq ft; aspect ratio, 7.53.

Weights: Max. take-off, 60,000 lb; capacity payload, 9,915 lb.

Payload accommodation: Total freight volume, 666 cu ft; max. seats, 45.

Fuel capacity: 2,032 Imp. gal.

Performance: Max. cont. cruise, 176 kt (204 m.p.h.) at 10,000ft and 56,000 lb; range A (max. payload), 1,890 st.m.; range B (max. fuel), 2,430 miles at 175 m.p.h. with 32 passengers and baggage and 60 lb of freight.

S.C.5 Britannic 3A Short's big freighter project was designed to a requirement for an aircraft that could carry 30,000 lb to Australia with only two intermediate stops. This was an R.A.F. Transport Command specification for a strategic freighter. A civil version would have equally impressive payload-range capabilities, both as an 85,000 lb capacity-payload freighter or as a 255-seat double decker 'bus. Both variants will have rear ramp-loading. No firm contract has yet been signed, but the Britannic could fly early in 1962, and a civil version could be made available in 1965 or 1966.

The Britannic owes much to the Britannia, although there is not now much physical relationship; earlier projects were Orion- or Proteus-powered and use of the Britannia wing was contemplated. Aerodynamic, structure and flying control development of the Britannia is being applied to the Britannic 3A and the wing design is broadly similar, although the four Rolls-Royce Tynes are on much wider centres. Design is being undertaken by Shorts, Bristol (wing), Boulton Paul (powerplant installation), and Saunders-Roe (rear fuselage). The price of the civil version would be between £1.6 and 1.7m, depending upon the equipment installed. Previous *Flight* references: February 20, 1959, September 4, 1959, and September 11, 1959. Operator's drawing: page 605.

Powerplant: Four Rolls-Royce Tyne RTy.12 of 5,730 e.h.p. take-off power at I.S.A. at sea level each driving 16ft de Havilland propellers.

Dimensions: Span, 158ft 9½in; length, 136ft 5in; height, 47ft; wing area, 2,466 sq ft (gross).

Weights: Max. take-off, 218,000 lb; max. landing, 205,000 lb; capacity payload, 85,000 lb; zero fuel, 196,000 lb; weight less fuel and payload, 110,315 lb.

Payload accommodation: Freight volume, 10,000 cu ft; cabin length, 84ft 6in; max. width, 16ft 1in; max. height, 13ft 9in; max. usable floor area, 1,014 sq ft.

Fuel capacity: 10,150 Imp. gal.

Performance: Cont. cruise speed, 320 kt (368 m.p.h.) at 20,000ft and 180,000 lb; corres. fuel consumption, 688 Imp. gal/hr; balanced field length, I.S.A., sea level, 6,950ft; I.S.A.+15 deg C, sea level, 7,500ft; I.S.A. at 5,000ft, 9,800ft; landing distance from 50ft, 6,700ft; range A (max. payload), 1,300 n.m. (1,500 st.m.); range B (max. fuel) 5,500 n.m. (6,300 st.m.); corres. payload, 25,800 lb; corres. speed, 304 kt (350 m.p.h.) at 28,000ft.

S.C.7 In May 1959 Shorts announced that they had formed a Light Aircraft Division to develop a general purpose transport, the S.C.7, as a private venture. It will carry a payload of 1½ tons, in the form of a car, freight or passengers and will be capable of operating from small fields. *Flight* references: May 8, 1959, and September 11, 1959.

Powerplant: Two U.S. piston engines, 340/390 h.p. each.

Dimensions: Span, 64ft 3in; length, 38ft 9in; wing area, 373ft.

Weights: Max. take-off, 8,250 lb; payload, 3,000 lb.

Payload accommodation: Cabin max. width, 6ft 6in; max. height, 6ft 6in; max. seats, 15.

Fuel capacity: 150 Imp. gal (180 U.S.).

Performance: Cont. cruise speed, 165 kt (190 m.p.h.) at 10,000ft; "minimum cost" cruise, 140 kt (161 m.p.h.); max. range cruise, 105 kt (120 m.p.h.); stalling speed, 49 kt (56 m.p.h.); take-off distance to 35ft, 1,260ft; landing distance from 30ft, 1,470ft; range A (max. payload), 174 n.m. (200 st.m.); range B (max. fuel), 930 n.m. (1,070 st.m.); corres. payload, 2,000 lb.

SUD-AVIATION *Société Nationale de Constructions Aéronautiques, 37, Boulevard de Montmorency, Paris.*

S.E.2010 Armagnac The biggest and heaviest piston-engined airliner to see regular service, the Armagnac first flew on January 12, 1949. Nine were built in 1950-53, and seven were flown regularly between Toulouse and Saigon during the 1955 Indo-China war by a joint Sud-Est (as Sud then was) - Air France company named SAGETA. Previously a number had been operated by the French airline T.A.I. One Armagnac was used as a flying engine test-bed by SNECMA. None is now operational.

Powerplant: Four P. & W. R-4360-B13 of 3,500 b.h.p., driving Curtiss propellers.

Dimensions: Span, 160ft 7in; length, 129ft 10½in; wing, 2,540 sq ft.

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

Weights: Max. take-off, 170,860 lb; capacity payload, 38,600 lb.

Payload accommodation: Cabin volume, 7,075 cu ft; cabin length, 81ft; max. width, 14ft 10in; max. seats, 107.

Fuel capacity: 6,710 Imp. gal (8,081 U.S. gal).

Performance: Cont. cruise speed, 15,000ft, 154,500 lb, 235 kt (270 m.p.h.); range A (max. payload), 1,930 n.m. (2,220 st.m.); range B (max. fuel), 3,415 n.m. (3,580 st.m.).

S.O.30P Bretagne Derived from the S.O.30N (Gnôme Rhone N 48/49) which first flew on February 26, 1945, and from the S.O.30R Bellatrix (Gnôme Rhone 14.Rs) which first flew on November 6, 1945, the Bretagne went into production to an Air France specification with P. & W. engines. About 50 were built up to 1954 and delivered to Aigle Azur (five), Air Maroc (six), Cosara (four), and to the French Services. It is believed that Cosara (a Saigon independent) still use four, and Bretagnes are still performing yeoman service with the French armed forces. Two versions were built, the 30P-1 with 2,000 h.p. P. & W. R-2800-43, and the 30P-2 with 2,400 h.p. P. & W. R-2800-CA18. The following data is for the 30P-1 :—

Powerplant: Two P. & W. R-2800-43 driving Curtiss Electric 13ft 5in propellers.

Dimensions (both versions): Span, 88ft 2in; length, 62ft 2in; wing area, 925 sq ft.

Weights: Max. take-off, 41,700 lb; capacity payload, 8,500 lb.

Payload accommodation: Cabin length, 40ft 8in; max. width, 9ft; max. seats, 43.

Fuel capacity: 1,040 Imp. gal (1,250 U.S.).

Performance: Cont. cruise speed, 20,000ft, 37,500 lb, 218 kt (250 m.p.h.); range A (max. payload), 539 n.m. (620 st.m.); range B (max. fuel), 1,680 n.m. (1,930 st.m.).

S.E.161 Languedoc A development of the Bloch 160 of 1937 and of the Bloch 161 which flew in 1939, the Languedoc was put into production with Gnôme Rhones in 1945, the first flying on September 17 of that year. Some 70 with P. & W. engines were built for Air France and LOT, and others for the French Air Force and Navy. Five are still in airline service with the Spanish operator Aviaco.

Powerplant: P. & W. R-1830-SC3Gs of 1,200 b.h.p. driving Hamilton 10ft 10in propellers.

Dimensions: Span, 96ft 5in; length, 79ft 7in; wing area, 1,200 sq ft.

Weights: Max. take-off, 52,250 lb; capacity payload 8,650 lb.

Payload accommodation: Cabin length, 36ft 8in; width, 6ft 7in; max. seats, 33.

Fuel capacity: 1,580 Imp. gal (1,900 U.S.).

Performance: Cont. cruising speed, 7,500ft, 50,700 lb, 189 kt (217 m.p.h.); range A (max. payload), 1,080 n.m. (1,240 st.m.); range B (max. fuel), 1,510 n.m. (1,740 st.m.).

S.E.210 Caravelle The decision to build the Caravelle was taken in January 1953 after a design competition: a French Government contract was awarded in July 1953 to Sud-Est Aviation (which combined with Ouest-Aviation to become Sud-Aviation in 1957), and the first Caravelle flew on May 27, 1955. Air France signed a contract for an initial order for 12 in February 1956. From May to November, 1956, the airline flew 600 hr on scheduled cargo proving-flights. Following certification in April 1959, Air France inaugurated scheduled services on May 12, 1959. The Caravelle is now in extensive European service with Air France and S.A.S., and other export deliveries are in progress.

The order book accounts for 55 aircraft, as follows :—

Air France, 24 (current); S.A.S., 17 (current delivery—four are for Swissair); Varig, 2 (current); Air Algérie, 4 (January-March 1960); Finnair, 3 (February-April, 1960); Royal Air Maroc, 1 (May 1960); Alitalia, 4 (May-July, 1960).

The Caravelle is the pioneer of two particular trends: short-range jet transportation (i.e., over stages of up to 1,000 n.m.) and rear-mounted jet engines, not the least important advantage of which is the unexcelled degree of cabin-quietness. *Flight* reference: July 25, 1958.

There are four main variants of the Caravelle, each being an exploitation of Rolls-Royce powerplant improvements :—

Caravelle 1 The first production deliveries are of this variant, which is powered by Avon 522s. Without structural modification, higher-powered Avons can be fitted, the designation then becoming Caravelle 3. An operator's drawing appears on page 605.

Powerplant: Two Rolls-Royce Avon 522 (RA.29/1) of 10,500 lb static thrust each.

Dimensions: Span, 112ft 6in; length, 105ft; height, 28ft 7in; wing area, 1,579 sq ft.

Weights: Max. take-off, 95,900 lb; landing, 91,338 lb; zero fuel, 77,160 lb; capacity payload, 18,450 lb; weight less fuel and payload, 58,600 lb.

Payload accommodation: Cabin volume, 3,000 cu ft; baggage and freight volume, 494 cu ft; cabin length, 52ft 6in; width, 9ft 10in; height, 6ft 10in; max. usable floor area, 646 sq ft; dimensions of largest door, 6ft × 2ft 5in; max. seats, 80 (five abreast).

Fuel capacity: 4,060 Imp. gal (4,980 U.S.).

Performance: Cont. cruise speed, 397 kt (456 m.p.h.) at 32,800ft and 80,900 lb; balanced field length, max. weight, sea level, I.S.A., 5,900ft; I.S.A.+15 deg C, 6,750ft; 5,000ft, I.S.A., 9,900ft; landing distance from 50ft, 5,315ft; range A (max. payload) 1,390 n.m. (1,600 st.m.); range B (max. fuel), 2,380 n.m. (2,740 st.m); corres. payload, 5,400 lb; corres. cruise speed, 398 kt (458 m.p.h.).

Caravelle 3 Powered by Avon 527s (RA.29/3) of 11,700 lb static thrust, this 99,208 lb version is the standard production aeroplane. Basic price: £950,000.

Powerplant: Two Rolls-Royce Avon 527 (RA.29/3), of 11,700 lb static thrust each.

Dimensions: As above.

Weights: Max. take-off, 99,208 lb; landing, 94,468 lb; zero fuel, 77,160 lb; capacity payload, 18,450 lb; weight less fuel and payload, 58,640 lb.

Payload accommodation: As above.

Fuel capacity: As above.

Performance: Cont. cruising speed, 435 kt (500 m.p.h.) at 32,800ft and 81,900 lb; corres. specific fuel consumption, 1.0; balanced field length, max. take-off weight, sea level, I.S.A., 5,900ft; I.S.A.+15 deg C, 6,700ft; 5,000ft I.S.A., 8,250ft; landing distance from 50ft, 5,530ft; range A (max. payload), 1,520 n.m. (1,750 st.m.); range B (max. fuel), 2,300 n.m. (2,645 st.m.); corres. payload, 8,100 lb; corres. cruise speed, 411 kt (473 m.p.h.).

Caravelle 6 This 1961 production version is again heavier—up to 103,620 lb—and takes advantage of the 12,500 lb thrust Avon 531 (RA.29/6). Both Caravelle 1s and Caravelle 3s can be converted to this standard, with changes to wheels, brakes, fin and other items. Conversion costs (as given by Air France) about £25,000.

Powerplant: Two Rolls-Royce Avon 531 (RA.29/6) of 12,500 lb static thrust each.

Dimensions: As above.

Weights: Max. take-off, 103,616 lb; landing, 98,650 lb; zero fuel, 78,269 lb; capacity payload, 18,450 lb; weight less fuel and payload, 59,220 lb.

Payload accommodation: As above.

Fuel capacity: As above.

Performance: Cont. cruise speed, 436 kt (501 m.p.h.) at 32,800ft and 92,000 lb; corres. specific fuel consumption, 0.975; balanced field length, max. take-off weight, sea level, I.S.A., 6,050ft; sea level, I.S.A.+15 deg C, 6,800ft; 5,000ft, I.S.A., 8,300ft; landing distance from 50ft, 5,840ft; range A (max. payload), 1,820 n.m. (2,095 st.m.); range B (max. fuel), 2,300 n.m. (2,645 st.m.); corres. payload, 11,650 lb; corres. cruise speed, 418 kt (481 m.p.h.).

Caravelle 7 A change of powerplant, to the Rolls-Royce RB.141/3 of 14,340 lb static thrust, signifies this projected variant for 1963, which will have a gross weight of 110,230 lb and a fuselage stretch of about 3ft. Seat-mile costs will be about the same as for previous versions, but speed will be up by more than 25 kt, and payload-range will be improved.

Powerplant: Two Rolls-Royce RB.141/3 by-pass turbojets of 14,340 lb static thrust each.

Dimensions: As above, except length, 108ft.

Weights: Max. take-off, 110,230 lb; landing, 104,985 lb; zero fuel, 81,570 lb; capacity payload, 19,400 lb; weight less fuel and payload, 62,170 lb.

Payload accommodation: As above, except for one extra seat row, max. seats being 85.

Fuel capacity: As above.

Performance: Cont. cruise speed, 448 kt (515 m.p.h.) at 32,800ft and 92,000 lb; balanced field length, max. weight, sea level, I.S.A., 6,000ft; sea level, I.S.A.+15 deg C, 6,650ft; landing distance from 50ft, 6,270ft; range A (max. payload), 2,200 n.m. (2,530 st.m.); range B (max. fuel), 2,380 n.m. (2,740 st.m.); corres. payload, 16,600 lb; corres. speed, 442 kt.

TUPOLEV Doyen of Russian aircraft designers, Andrei Nikolaevich Tupolev, like his rival Ilyushin, has produced a notable family of bomber and transport aircraft. Among these is Russia's first jet airliner, the Tu-104, a development of the so-called Badger bomber.

Tu-104 This twin-jet airliner has been built in three versions. The first was in effect a "prestige" aircraft, seating 50 passengers in somewhat sombre luxury, whereas the second version, the Tu-104A, seats 70 in a more austere, but nevertheless comfortable, manner. The Tu-104B, which is becoming Aeroflot's standard jet, has a longer fuselage and can seat up to 100 in five-abreast seats. A number of speed-with-load records are held by the Tu-104A and B, both of which are in Aeroflot service to the extent of many scores (certainly well over a hundred).

Powerplant: Two Mikulin AM-3 turbojets of about 19,000 lb thrust (the Tu-104B has improved engines of the same type, believed to give lower specific fuel consumption).

Dimensions (Tu-104A and B): Span, 113.32ft; length (Tu-104A), 127.45ft; length (Tu-104B), about 131ft.

Weights: Empty, 43,000 lb approx.; max. take-off, over 160,000 lb.

Payload accommodation (Tu-104B): In this version the front pressure bulkhead is farther forward than on the Tu-104A. The first cabin seats 30, the second 15, the third 55. Luggage and cargo compartments are 424 cu ft greater in capacity than those of the Tu-104A; the loading doors are built into the side panels and not into the bottom of the fuselage, as on the "A" version.

Performance: Normal cruising speed, about 435 kt (500 m.p.h.); max. speed 550 kt (633 m.p.h.); max. range, over 2,500 miles.

(*Continued on page 620, after two double-page drawings*)

Sud Armagnac (Pratt & Whitney R-4360-B13)

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

VICKERS VANGUARD

Reference: page 621

Fuselage

1 Ekco E.152/24 weather radar
2 Upward-hinging radome
3 Three windscreen wipers
4 Front pressure bulkhead
5 Electrically heated windscreen panels
6 D.V. panel (single panel on T.C.A. aircraft)
7 Access panel to underfloor controls
8 Nose-undercarriage box
9 Circuit-breaker panels
10 Crew emergency fixed oxygen supply bottle, 750 litre
11 Taxying lamp
12 Pressure head
13 Static vents
14 Radio racking
15 Additional radio equipment
16 Galley service and emergency-exit door
17 Windows 26in by 19in
18 Emergency-exit windows
19 Emergency-exit door
20 Interlinked upper and lower freight doors, 66in by 46in
21 Forward freight hold, 750 cu ft
22 Aft freight hold, 610 cu ft
23 Freight hold lighting
24 Access to electric inverters, T.R.U.s, master gyro, cooling air to inverters is extracted by the inverter cooling fans
25 Six batteries for 28 V system
26 Stressed floor panels
27 Galley
28 Coat stowage
29 Extended air-steps
30 Forward passenger door, 73in by 42in
31 Aft passenger door, 73in by 42in
32 Retracted air-steps
33 Air-steps hydraulic jack
34 Air-steps folding cam-track
35 Door-opening linkage
36 Parallel-linkage hinges
37 Steward's remote door control
38 Hydraulics bay, access from underneath
39 Hydraulic reservoir
40 Hydraulic accumulator
41 External door release
42 Seat-pitch in this area 36in in 96-seat configuration
43 Seat side-attachment anchorages
44 Tip-up steward seat (two portable oxygen sets under)
45 Washing water tanks
46 Toilets (total four)
47 Toilet servicing
48 Glass-wool insulation
49 Steward call-panel, also provision for controlling cabin temperature
50 Escape-rope stowage
51 Access ladder to freight hold
52 Anti-glare blinds
53 Supernumerary crew-seat
54 Pilot sun-blind
55 Aft pressure bulkhead
56 Main empennage frames
57 Tailplane attachment points
58 Electro-thermal (Spraymat) de-icing
59 Cyclic switch, fuses and contact breakers for item 58
60 Honeycomb-stabilized skin
61 Dielectric tip
62 Detachable leading edges tailplane and mainplane

Cabin Air System

63 Screw-type cabin blower
64 Air intake for item 63
65 Primary silencer
66 Spilled air outlet
67 Silencer for 66
68 Main air supply duct
69 Duct pressure relief valve
70 Ground air supply point
71 Ram air to secondary cooler
72 Secondary cooler (primary to port); cold-air cycle
73 Ground running fan (air turbine-driven axial flow fan draws air through the secondary heat exchanger for the cooling cycle when aircraft is on the ground)
74 Cold air unit
75 Silencer and water-extractor
76 Non-return valve, mixing valve and booster fan
77 Unpressurized-flight valve
78 Recirculating air duct
79 Recirculation check valve interconnected with unpressurized flight valve
80 Recirculation fan
81 Hot air to 76
82 Cold air to 76
83 Conditioned (warm) air
84 Cold-air duct to individual outlets
85 Passenger service box containing individual cold air outlets, reading lamps and steward's call button sliding along the hat racks
86 Wall-heating cells
87 Air extraction to freight holds

Control Systems

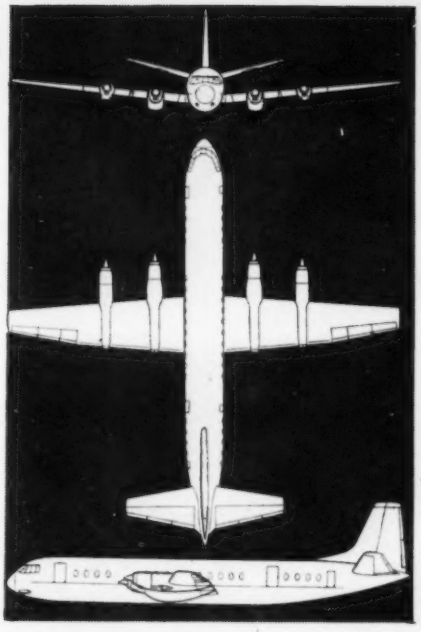
88 Underfloor pedal linkage
89 Push/pull control tubes and cables running below wing torsion box
90 Control-tube swinging brackets
91 Control-run gland box
92 Elevator autopilot servos
93 Rudder autopilot servos
94 Rudder and elevator control locks
95 Control-lock cylinders
96 Spring tab
97 Spring/trim tabs (inboard tab on each aileron and lower tab on the rudder)
98 Geared servo-tab
99 Trim tab
100 Anti-upfloat unit
101 Sealed-balance control surfaces
102 Inspection panels in upper and lower surfaces
103 Engine control runs

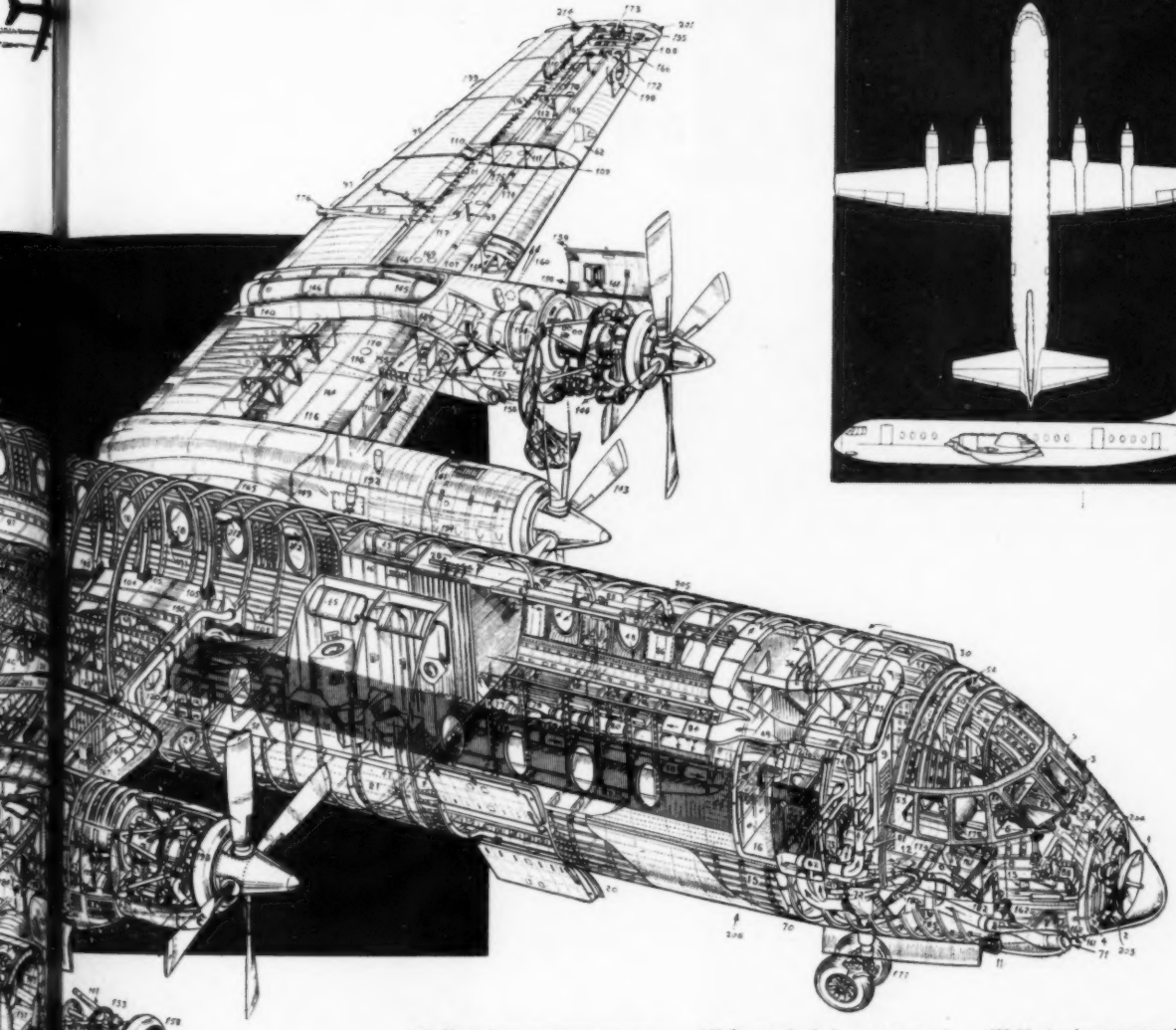
Wing Structure

104 Centre torsion box (dry)
105 Machined wing/fuselage attachments
106 Butt-strap and web plates for centre-section/inner-wing joint
107 Butt-strap at inner-wing/outer-wing joint
108 Detachable tip unit
109 Torsion-box front web
110 Torsion-box rear web
111 Torsion-box centre member
112 Termination of centre web
113 Machined box-closing ribs
114 Tank-inspection panels
115 Machined, integrally stiffened skin, 54 panels
116 Four panels top and bottom in inner wing
117 Three panels top, four panels bottom, in outer wing
118 Multi-bracket rib/skin joint
119 Leading-edge attachment points
120 Manholes for access to interior
121 Forged fittings for nacelle longerons
122 Boundary ribs to jet-pipe bay
123 Aileron bay
124 Access panel to accessory bay

Flaps

125 Fowler area-increasing flaps (one section removed)
126 Flap rails





127 Roller track units
128 Cable guide pulleys
129 Flap actuator (hydraulic jack with quick-thread to give irreversible rotary output)
130 Flap torque-tube driving 131
131 Flap-actuating cable drums
132 Port flap sections illustrated in fully-up position

Powerplants

133 Rolls-Royce Tyne 1 turboprops installed as completely equipped engine-change units
134 Rotol accessory gearbox: inners, cabin blower, one alternator, propeller brake unit and hydraulic pump; outers, two alternators, propeller brake unit and hydraulic pump
135 Station 'O' firewall (Zone 1 forward of this bulkhead)
136 Station '26' firewall (Zone 2 between Stn. 'O' and 24)
137 Horizontal firewall (Zone 2a below)
138 Zone 1 venting air, via cowl leading-edge gap
139 Alternator cooling intake
140 Zone 3 venting air
141 Bleed from low-pressure compressor, for discharge of surplus air during starting cycle
142 Engine mounting lugs
143 de Havilland 14ft 6in propellers
144 Airflow through twin oil coolers
145 Flattened jet-pipes
146 Jet-pipe roller guides
147 Jet pipe shroud, with Thermoflex covering
148 Mating ring between engine and jet-pipe
149 Waisted nacelle

Ice Protection

150 Heat exchanger
151 Jet-pipe valve feeding 150
152 Exhaust from 150
153 Ram intake to 150
154 Warm air through leading edge
155 Anti-icing air exhausts (tip, and outboard nacelles)
156 Cross-feed pipe
157 Hot air from inlet guide vanes fed to oil-cooler intake
158 Electro-thermal system on engine intake
159 Slip-rings for electro-thermal system on propeller spinner and blades
160 Leading-edge inspection lamps
161 Ice detector
162 Outside-air-temperature probe
163 Windscreen de-icing fluid tank and pump

Fuel System

164 Integral tanks: outers, 700 Imp. gal each; inners, 1,850 Imp. gal each
165 Four-tank fuel system, total capacity 5,100 Imp. gal
166 Tank end ribs
167 Booster pumps, two per tank
168 Magnetic fuel-level indicators (six)
169 Fuel-gauge tank units (eleven)
170 Gravity fillers
171 Pressure fuelling/defuelling socket and control panel
172 Pressure-relief valve
173 Twin float-operated vent valve
174 Vent pipe from inner tank
175 Outer tank vent pipe
176 Overflow/vent manifold

Undercarriage

177 Nosewheel tyres 33in x 9.75in
178 Nosewheel steering wheels
179 Jack
180 Breaker strut
181 Up-lock
182 Leg-operated doors, beam and linkage
183 Wheel anti-spin brakes
184 Forward retracting twin-wheel units under box-spar centre member
185 Jack attached to box-spar rear member
186 Breaker-strut to box spar front member (see wing-section overleaf)
187 Dunlop tyres 50in wheels, brakes, Maxaret (Goodyear in T.C.A. aircraft)
188 Blisters in top of wheel-well
189 Leg-well doors linked to wheel-well doors
190 Moving leg operates doors via beam and linkage
191 Door inner skin relieved for wheel

Miscellaneous

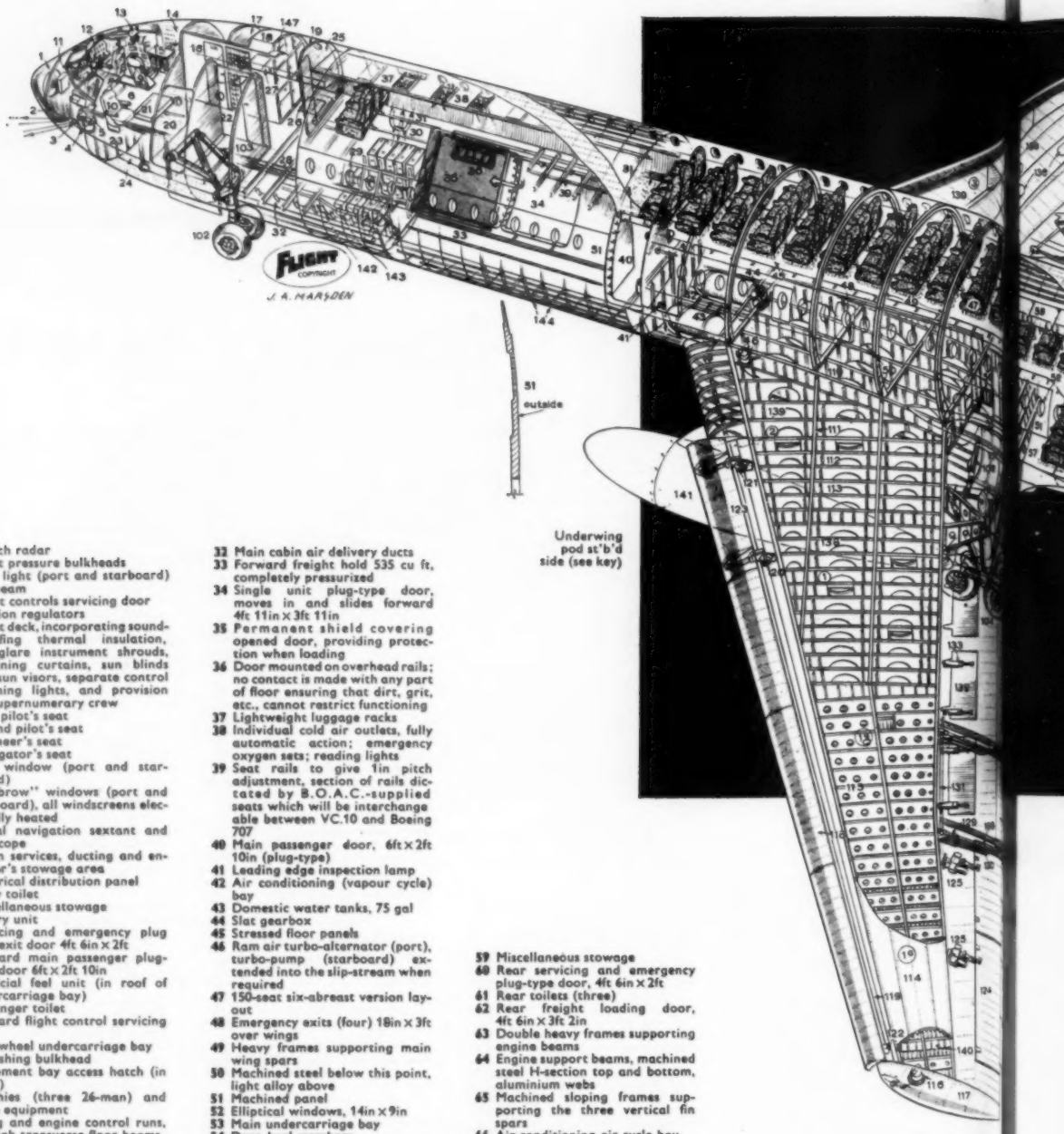
192 Two fire suppression bottles each nacelle (two-shot system)
193 Spray-rings, Zones 1 and 2 (Firewire system)
194 Fire access panels
195 Centralized drains, tank and outlet
196 Cowling drains
197 Fuel-tank water drains
198 Retractable landing lamp under each wing tip (access panel open)
199 Static dischargers
200 Glass-fibre cable ducts throughout
201 Flashing navigation lights
202 H.F. slot
203 Glide slope
204 V.H.F. stand-by
205 V.H.F.
206 Radio altimeter (on centre-line)
207 H.F. wire
208 I.L.S. localizer
209 Fin tip I.L.S./V.O.R. localizer
210 V.H.F. No. 2 (port side)
211 A.D.F. sense
212 Suppressed A.D.F. loops
213 H.F. tuning unit
214 Flux detector
215 Freight lashing points
216 Vortex generators

COMMERCIAL AIRCRAFT OF THE WORLD

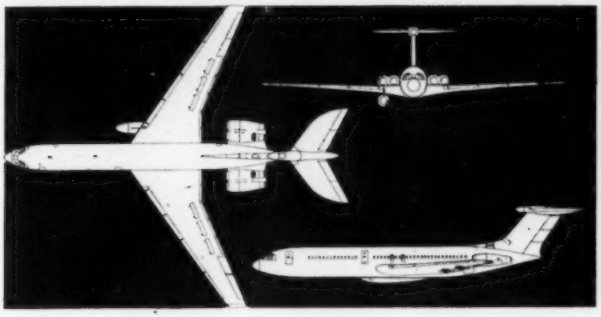
Index by Aircraft Page 621
Explanatory Notes Page 577

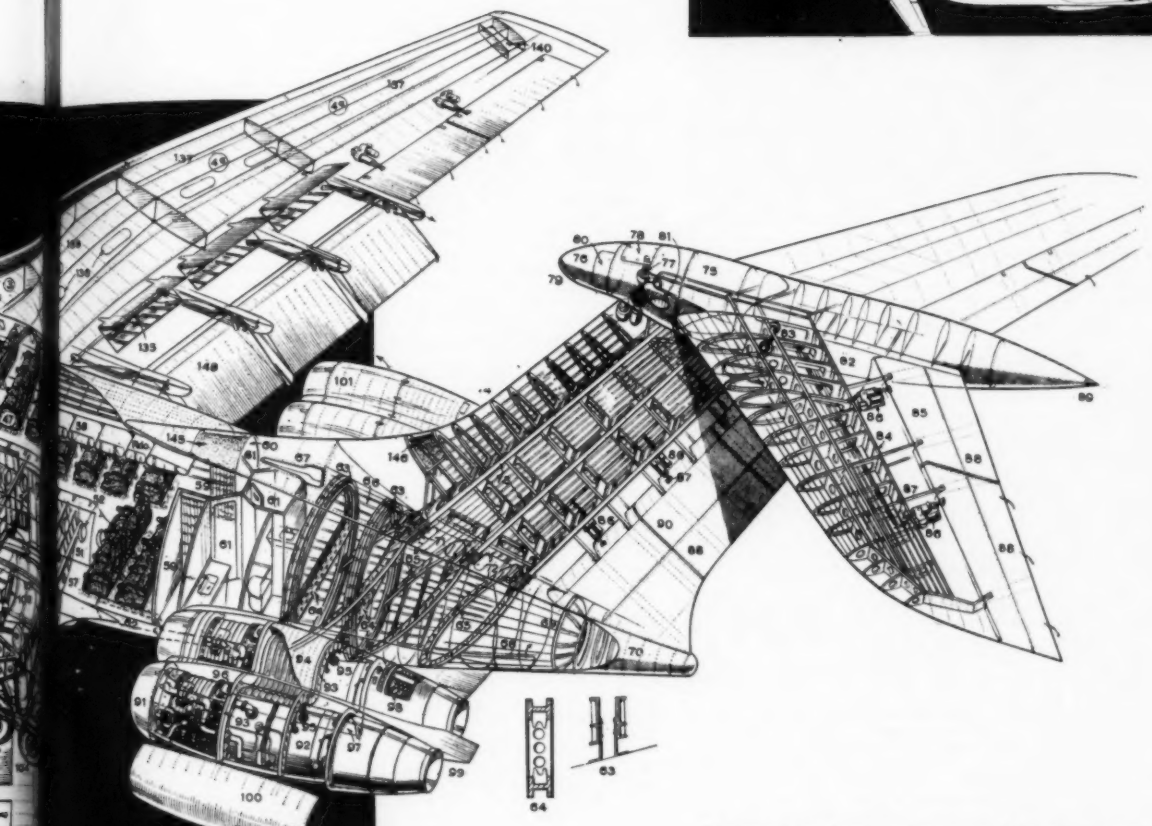
VICKERS VC.10

Reference: page 621



1 Search radar
2 Front pressure bulkheads
3 Taxi light (port and starboard) 50° beam
4 Flight controls servicing door
5 Tension regulators
6 Flight deck, incorporating sound-proofing thermal insulation, anti-glare instrument shrouds, screening curtains, sun blinds and sun visors, separate control dimming lights, and provision for supernumerary crew
7 First pilot's seat
8 Second pilot's seat
9 Engineer's seat
10 Navigator's seat
11 D/V window (port and starboard)
12 "Eyebrow" windows (port and starboard), all windscreens electrically heated
13 Astral navigation sextant and periscope
14 Cabin services, ducting and engineer's stowage area
15 Electrical distribution panel
16 Crew toilet
17 Miscellaneous stowage
18 Pantry unit
19 Servicing and emergency plug type exit door 4ft 6in × 2ft
20 Forward main passenger plug-type door 6ft × 2ft 10in
21 Artificial feel unit (in roof of undercarriage bay)
22 Passenger toilet
23 Forward flight control servicing bay
24 Nosewheel undercarriage bay
25 Furnishing bulkhead
26 Equipment bay access hatch (in flight)
27 Dinghies (three 26-man) and radio equipment
28 Flying and engine control runs, through transverse floor beams
29 Forward radio, oxygen and electronics services bay, fully pressurized and provided with cooling fans to keep temperature constant
30 Radio equipment cooling duct
31 Cabin recirculating air duct
32 Main cabin air delivery ducts
33 Forward freight hold 535 cu ft, completely pressurized
34 Single unit plug-type door, moves in and slides forward 4ft 11in × 3ft 11in
35 Permanent shield covering opened door, providing protection when loading
36 Door mounted on overhead rails; no contact is made with any part of floor ensuring that dirt, grit, etc., cannot restrict functioning
37 Lightweight luggage racks
38 Individual cold air outlets, fully automatic action; emergency oxygen sets; reading lights
39 Seat rails to give 1in pitch adjustment, section of rails dictated by B.O.A.C.-supplied seats which will be interchangeable between VC.10 and Boeing 707
40 Main passenger door, 6ft × 2ft 10in (plug-type)
41 Leading edge inspection lamp
42 Air conditioning (vapour cycle) bay
43 Domestic water tanks, 75 gal
44 Slat gearbox
45 Stressed floor panels
46 Ram air turbo-alternator (port), turbo-pump (starboard) extended into the slip-stream when required
47 150-seat six-abreast version layout
48 Emergency exits (four) 18in × 3ft over wings
49 Heavy frames supporting main wing spars
50 Machined steel below this point, light alloy above
51 Machined panel
52 Elliptical windows, 14in × 9in
53 Main undercarriage bay
54 Deep keel members
55 Machined keel longeron member
56 Access holes for inspection
57 Rear freight hold, 815 cu ft, completely pressurized
58 Rear dinghies, 26 and 10-man (drop from roof, mechanically damped), and radio equipment
59 Miscellaneous stowage
60 Rear servicing and emergency plug-type door, 4ft 6in × 2ft
61 Rear toilets (three)
62 Rear freight loading door, 4ft 6in × 3ft 2in
63 Double heavy frames supporting engine beams
64 Engine support beams, machined steel H-section top and bottom, aluminium webs
65 Machined sloping frames supporting the three vertical fin spars
66 Air conditioning air cycle bay
67 Primary flush air intake (port and starboard)
68 Rearmost freight loading door
69 Rear pressure dome
70 Rear tail cone
71 Fin spar pick-up points (Vickers tapered bolts)





72 Inspection panels
73 Fin spar torsion box, stiffened web and rail
74 Leading edge containing thermal de-icing
75 Bullet fairing
76 Removable nose cap
77 Tailplane incidence hydraulic jack
78 Access panel to tailplane jack, and follow-up shaft
79 Glide-slope aerial
80 I.L.S. aerial
81 Leading edge inspection lamp
82 High set, variable incidence tailplane adjusted through an angle of +4° to −14°
83 Tailplane pivot point
84 Three spar torsion box
85 Electrically operated four-section split control elevators
86 Boulton Paul hydro-electric control unit
87 Elliott autopilot actuators integrated into the system; each actuator is connected into the linkage so as to operate all four split surfaces
88 This portion honeycomb-stabilized skin
89 Navigation light
90 Three-section rudder, operating with Elliott autopilot system and yaw damper
91 Electro-thermal system to anti-ice leading edge
92 Rolls-Royce Conway RCo. 42 twin-spool, axial-flow by-pass engine
93 Machined steel engine support spectacle beams
94 Engine pod torsion box
95 Fore and aft swinging "A" support bracket
96 Single point attachment front trunnion
97 Stainless steel firewall isolating engines
98 Thrust reversing unit (inner engines only)
99 Engines at rear giving low asymetric thrust
100 Lower cowlings hinge down
101 Top front cowlings hinge forward
102 Forward retracting undercarriage, fully steering, low pressure tyres 39in × 13in
103 Nosewheel jack
104 Main four-wheel bogie undercarriage, tyres 50in × 18in-20in
105 Breaker strut
106 Undercarriage jack
107 Undercarriage auxiliary machined spar
108 Undercarriage/fuselage fairing door
109 Wing well door attachment to undercarriage leg
110 Centre wing torsion box, incorporating fuel transfer tanks, 4,220 gal
111 Three-spar (four spars in this area) fail-safe torsion box wing
112 Heavy plate-type ribs
113 Internal manholes giving complete accessibility
114 Multi-machined, integrally stiffened stringer panels
115 "Thiokol" sealed integral wing tanks
116 Retractable landing lamp under each wing tip
117 Detachable wing tips
118 Four-part hydraulically operated wing slats, opened or closed, no intermediate position
119 Slat torque tube
120 Slat actuator unit
121 Slat jack
122 Slat synchro unit
123 Thermal de-iced leading edge (exhausted through wing tip)
124 Four-part ailerons
125 Boulton Paul hydro-electric control unit (incorporating Elliott autopilot actuators)
126 Driwick static dischargers
127 Five-part electrically actuated Fowler-type flaps
128 Flap worm shaft
129 Flap torque link and carriage
130 Roller guide
131 Torque shaft
132 Three-part spoilers on top surface
133 Spoiler operating hydraulic jack
134 Anti-icing inspection lamp
135 Spoilers shown open
136 Tank inspection panels on top surface
137 Outer tanks, 1,430 Imp. gal (A1 and 4A)
138 Outer tanks, 1,880 Imp. gal (1 and 4)
139 Inner tanks, 3,230 Imp. gal (2 and 3)
140 Vent tanks
141 Pod on starboard wing to carry spare engine and lifting tackle (shown on port wing), engine interchangeable with Boeing 707
142 D.M.E. aerial
143 Radio altimeter / D.M.E./Tacan — under
144 D.M.E. and aerials
145 Loran aerial
146 H.F. aerial
147 V.H.F. aerial
148 Flaps extended (port side disconnected)

Vickers Vanguard (Rolls-Royce Tyne RTy. 11s)

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft Page 621
Explanatory Notes Page 577

Tu-110 This four-jet development of the Tu-104 series, with a fuselage about 10ft longer and seating 100, has now been abandoned, in view of the successful development of the Tu-104B.

Tu-114 This is the largest airliner in the world and has been adopted by Aeroflot as a standard type. The first Tu-114 flew in 1957, and four or more are believed to exist, one of which has flown non-stop from Moscow to New York. The Tu-114 is a civil development of the so-called Bear strategic bomber. Aeroflot expect to inaugurate services before the end of this year; early routes will probably be Moscow - Khabarovsk and Moscow - Peking. An operator's drawing appears on page 604.

Powerplant: Four NK-12 turboprops, probably de-rated from the military power of 12,000 s.h.p. to 9,000-10,000 s.h.p. Eight four-blade, contra-rotating propellers of over 18ft diameter, with electric synchronizing and pneumatic emergency feathering.

Dimensions: Span, 177ft 2in; length, 154ft 10in; height, 38ft 8in; wing area, 3,014 sq ft.

Weights: Max. take-off weight is believed to be in excess of 400,000 lb.

Payload accommodation: This was fully described in *Flight* of August 21, 1959. A Russian document states that passenger capacity is from 120-220, depending on range. The version seen at the Paris Show this year had 170 seats (not counting a 48-seat dining hall).

Performance: Not precisely known, but the Russians claim that the aircraft can fly non-stop from Moscow to Vladivostock, Peking, New York or Rangoon in 10-12 hr. Cruising speeds on recent long-range flights have been of the 400-420 kt order (460-490 m.p.h.).

Tu-114D This is more or less a conversion of the Bear bomber, and Mr. Tupolev has stated that it is intended to transport quite a small number of passengers with baggage, mail and other urgent freight over very long distances. One flight of 5,350 miles has been made at an average speed of about 435 kt (500 m.p.h.), and on landing the pilot stated that sufficient fuel remained for a further flight of 930-1,250 miles.

VICKERS-ARMSTRONGS (AIRCRAFT) *Weybridge, Surrey, England.*

Viking Designed as a replacement for the Douglas DC-3, and derived from the Wellington bomber, the unpressurized VC-1 Viking first flew on June 22, 1945. Three main versions of this 21-27 passenger airliner were produced: the Viking IA with wings and tailplane of fabric-covered geodetic, the Viking I with wings and tailplane of conventional metal construction and—the most numerous variant—the Viking IB, which featured a 28in longer forward fuselage. A total of 166 Vikings were built, including three prototypes. B.E.A. was the first Viking operator and many ex-B.E.A. aircraft are in service with British and continental independents. A total of 102 Vikings are owned by 25 airlines; some have been converted to freighters. Current secondhand market price is about £20,000, although Vikings have been offered for £5,000.

Powerplant: Two Bristol Hercules 634 of 1,675 b.h.p. driving 13ft 3in de Havilland or Rotol four-bladed propellers.

Dimensions: Span, 89ft 3in; length, 62ft 10in; height, 19ft 6in; wing area, 882 sq ft.

Weights: Max. take-off, 34,000 lb; landing, 33,250 lb; capacity payload, 7,120 lb; weight less fuel and payload, 24,000 lb.

Payload accommodation: Cabin volume, 1,665 cu ft; baggage and freight volume, 250 cu ft; cabin length, 39ft 3in; max. width, 7ft 11in; max. height, 6ft 8in; usable floor area, 249 sq ft; max. seats, 27.

Fuel capacity: 750 Imp. gal (5,400 lb).

Performance: Cont. cruising speed, 182 kt (209 m.p.h.) at 10,000ft and 32,500 lb, with fuel consumption of 88 Imp. gal/hr; balanced field length, sea level, I.S.A., 3,600ft; landing distance from 50ft (unfactored), 3,650ft. Range A (max. payload), 1,000 n.m. (1,150 st.m.); range B (max. fuel), 1,946 n.m. (2,242 st.m.) at 149 kt (171 m.p.h.) at 10,000ft with 4,600 lb payload.

Viscount 700D The Viscount had its origins in the Brabazon Committee Type IIB requirement of March 1945 for "a 24-seat aircraft, powered with four gas turbine engines driving airscrews for European and other short-to-medium range services." The V.630 Viscount prototype, seating up to 36 passengers, made its first flight on July 16, 1948, but for B.E.A. it was stretched into the V.700 with 1,400 s.h.p. RDa.3 Darts and seating up to 53 passengers; the prototype V.700 first flew on August 28, 1950. A month before, the V.630 prototype had been used by B.E.A. on the world's first scheduled commercial passenger services with a turbine-powered aeroplane; the Corporation commenced services with its production V.701s on April 19, 1953. A total of 285 V.700s have so far been sold; the basic V.700D differs from the V.700 in having the more powerful RDa.6 Darts, more fuel and increased take-off weight.

Considerable effort was expended in making the Viscount suitable for North American use after T.C.A.'s initial contract for 15 aircraft was placed in 1952. These changes included conversion for two-pilot operation with U.S. instruments, radio and other equipment, provision for weather radar, carry-on luggage racks, airstairs and braking units on the port propellers. These features were also embodied in the 65-seat V.790 variant for U.S. and other local service carriers which was not built, but B.E.A.'s V.701 Viscounts are being converted to a high density version with 63 seats and airstairs. The Viscount 700's secondhand price is around £200,000-£250,000, although the market for these aircraft seems to be temporarily inactive. New aircraft can still be purchased from Vickers; the 700 D price is £400,000 ($1,100,000).

Flight references: July 15, 1955 (history and origins; development of North American versions), January 31, 1958 (Local Service Viscount).

Powerplant: Four Rolls-Royce RDa.6 Dart 510 turboprops of 1,740 e.h.p. (1,600 s.h.p.) each driving 10ft Rotol propellers.

Dimensions: Span, 93ft 8½in; length, 81ft 10in; height, 26ft 9in; wing area, 963 sq ft.

Weights: Max. take-off, 64,500 lb; landing, 57,500 lb; zero fuel, 50,168 lb; capacity payload, 11,842 lb; weight less fuel and payload, 38,326 lb.

Payload accommodation: Cabin volume, 2,230 cu ft; baggage and freight volume, 358 cu ft; cabin length, 45ft; max. width, 9ft 11in; max. height, 6ft 6in; usable floor area, 430 sq ft; dimensions of largest door, 63½in × 55in (elliptical); max. seats, 53.

Fuel capacity: 1,967 Imp. gal plus 75 Imp. gal water-methanol.

Performance: Cont. cruising speed, 270 kt (310 m.p.h.) at 20,000ft and 57,500 lb; corres. fuel consumption, 320 gal/hr; balanced field length at max. take-off weight, sea level, I.S.A., 5,310ft; sea level, I.S.A. +15 deg C, 5,850ft; 5,000ft, I.S.A., 7,200ft; landing distance from 50ft (unfactored), 2,920ft; range A (max. payload), 1,518 n.m. (1,748 st.m.); range B, 1,678 n.m. (1,932 st.m.) at 271 kt (311 m.p.h.) with 10,400 lb payload.

Viscount 800, 810, 840 Development of a stretched version of the Viscount had been started by B.E.A. and Vickers before the V.701 had entered airline service, and on February 11, 1953, B.E.A. ordered 12 V.801 Viscounts. This version, powered by four 1,690 e.h.p. RDa.5 Darts, was to have had a fuselage 13ft 3in longer than the V.701s. But the V.801 was abandoned because it was too large for traffic requirements as then foreseen, and it was replaced by the V.802, for which B.E.A. placed an initial order on April 14, 1954. This version is 3ft 10in longer than 700-series Viscounts, but this stretch, together with moving the rear pressure bulkhead back 5ft 5in, gives an extra 9ft 3in of usable cabin length, and a seating capacity of up to 70. Powered by the same Dart 510s as the Viscount 700D, the first 800-series Viscount, a V.802 for B.E.A., had made its initial flight on July 27, 1956, and entered passenger service on the London - Paris route on February 18, 1957. A total of 66 Viscount 800s has been sold to seven airlines; this total includes B.E.A.'s V.806s which are, in effect, interim versions because they have 1,890 e.h.p. (max. take-off) RDa.7 Dart 520 turboprops, while the Viscount 810 has 1,990 e.h.p. RDa.7/1 Dart 525s.

Apart from more powerful Darts, the Viscount 810 differs from the 800 in having a structure strengthened to cater for a higher landing weight and an ultimate cruising speed of 400 m.p.h. This 810 version of the Vickers turboprop came about largely because of a Continental Air Lines' requirement for a Viscount with the increased capacity of the V.800, but with more power (to overcome the temperature/altitude limitations of such hot and high mid-Western airports as Denver), and range sufficient for the non-stop operation of such sectors as Denver - Los Angeles. Other operators ordered Viscount 810s, and 57 have been sold so far to 11 airlines and to one executive operator. Hunting-Clan's three V.833s have non-standard Dart 530s which, unlike the Dart 525s, are not de-rated; they give the full 2,105 e.h.p. for take-off, thus overcoming temperature/altitude limitations on the African Safari routes, whereas the Dart 525 engine is de-rated from 2,105 e.h.p. to 1,990 e.h.p. for take-off. The true 400 m.p.h. Viscount is the Viscount 840, which differs from the 810 in having more powerful RDa.11 Dart 541s of 2,350 e.h.p. each for take-off; these give it a 400 m.p.h. cruising speed. Viscount 810s can be converted to 840 standard, and Viscount 840s will be built if orders are obtained.

A grand total of 408 Viscounts of all versions has been sold to 51 operators—40 of whom are airlines—in 32 countries. A handful of executive Viscount 700s, some of which are operated in military markings, have been supplied to various foreign governments as V.I.P. and personnel transports. References: *Flight*, February 22, 1957 (Viscount 802 description); February 28, 1958 (Viscount 810 description) and April 17, 1959 (order book). An operator's drawing appears on page 602. The following figures apply to the Viscount 810:—

Powerplant: Four Rolls-Royce RDa.7/1 Dart 525 turboprops of 1,990 e.h.p. (1,800 s.h.p. plus 500 lb thrust), driving 10ft Rotol propellers.

Dimensions: Span, 93ft 8½in; length, 85ft 8in; height, 26ft 9in; wing area, 963 sq ft.

COMMERCIAL AIRCRAFT OF THE WORLD

Index by Aircraft See Below
Explanatory Notes Page 577

Weights: Max. take-off, 72,500 lb; landing, 62,000 lb; zero fuel, 57,500 lb; max. payload, 15,200 lb; weight less fuel and payload, 42,300 lb.

Payload accommodation: Cabin volume, 2,680 cu ft; baggage and freight volume, 370 cu ft; cabin length, 54ft; max. width, 9ft 11in; max. height, 6ft 6in; usable floor area, 520 sq ft; dimensions of largest door, 64in × 36in; max. seats, 70.

Fuel capacity: 1,900 Imp. gal (2,280 U.S. gal), plus 110 Imp. gal (132 U.S. gal) water-methanol.

Performance: Cont. cruise speed, 305 kt (351 m.p.h.) at 20,000ft and 62,000 lb; corres. fuel consumption, 380 Imp. gal/hr; balanced field length, sea level, I.S.A., 6,200ft; at sea level, I.S.A., +15 deg C, 6,650ft; at 5,000ft, I.S.A., 8,170ft; landing distance from 50ft (unfactored), 3,150ft; range A (max. payload) 1,500 n.m. (1,725 st.m.); range B (max. fuel) 1,530 n.m. (1,760 st.m.); corres. payload, 15,000 lb; range B with slipper tanks, 1,930 n.m. (2,220 st.m.).

V.950 Vanguard The Vanguard was the culmination of two years' detailed discussion between B.E.A. and Vickers and Rolls-Royce, in 1954 and 1955, for a Viscount replacement. The Corporation drew up a 50-page specification early in 1955 and in October of that year placed an order for 20 aircraft at a price, with spares, of approximately £1 million each. In January 1957, after "one of the most exhaustive analyses ever undertaken," T.C.A. placed an order for 20 aircraft and parts worth £23.9 million, with an option on a further four.

The first Vanguard, G-AOYW, made its first flight on January 20, 1959, and the flight test programme, due to culminate with full certification in March 1960 (by which time 1,500 hours will have been flown by the six aircraft) is on schedule. Four aircraft are now flying on test, and the first deliveries to B.E.A. are due to be made soon after certification in March 1960. The first B.E.A. Vanguard services will be inaugurated, on the Paris route, on July 1, 1960.

B.E.A. will have six Type 951s, with Rolls-Royce Tyne 506s, and with a maximum weight of 135,000 lb. The remaining 14 aircraft will be Type 953s with the same engines but with a higher maximum weight (141,000 lb) and increased payload. T.C.A.'s aircraft will be Type 952 with Tyne 512s of 5,545 e.h.p.—560 e.h.p. more than the Tyne 506. Deliveries of T.C.A.'s aircraft are due to begin in July 1960.

An all-freighter version of the Vanguard, with a 64,000 lb payload and a maximum weight of 166,000 lb is offered, and an all-freight version with rear loading doors is also projected. This version would have a payload of 62,000 lb.

Vickers claim that, on the basis of current European costs and revenues, the Vanguard in its 139-seater economy-class rôle and at a 65 per cent passenger load factor can make a 10 per cent profit at fares 50 per cent less than current European rates.

Flight references: January 9, 1959 (special issue); July 25, 1958, page 129. A cutaway drawing appears on pages 616 and 617.

The following data are for the V.950 Vanguard, this version being based on that for T.C.A.:—

Powerplant: Four Rolls-Royce Tyne RTy.11 (Mk 512) turboprops of 5,545 e.h.p. each, driving de Havilland Hydromatic trapezoidal-blade 14ft 6in propellers.

Dimensions: Span, 118ft; length, 122ft 10½in; height, 34ft 11in; wing area, 1,529 sq ft.

Weights: Max. take-off, 141,000 lb; landing, 121,000 lb; zero fuel, 112,500 lb; capacity payload, 29,000 lb; weight less fuel and payload, 83,500 lb.

Payload accommodation: Cabin volume, 5,690 cu ft; baggage and freight volume, 1,360 cu ft; cabin length, 90ft; max. width, 10ft 7in; max. height, 6ft 10½in; max. usable floor area, 893 sq ft; dimensions of largest doors, 6ft × 3ft 6in (passenger door), 3ft 10in × 5ft 6in (freight).

Fuel capacity: 5,100 Imp. gal (6,125 U.S. gal).

Performance: Cont. cruise speed (normal cruise technique), 367 kt (422 m.p.h.) at 20,000ft and 121,000 lb; corres. fuel consumption, 710 Imp. gal/hr; balanced field length, max. take-off weight, sea level I.S.A., 6,200ft; sea level I.S.A.+15 deg C, 7,500ft; 5,000ft I.S.A., 8,500ft; landing distance from 50ft (unfactored), 3,500ft; range A (max. payload), 2,140 n.m. (2,470 st.m.); range B (max. fuel), 2,910 n.m. (3,350 st.m.); corres. payload, 19,100 lb; corres. cruise speed (max. range technique, 30,000ft), 343 kt (394 m.p.h.).

VC.10 Now under construction at Weybridge and Hurn are components of the first of 35 VC.10s ordered by B.O.A.C. for delivery in 1963. An intention-to-order was announced in May 1957 and the contract (which includes options on an additional 20 aircraft) was signed in January 1958. All VC.10s will be production aircraft and the first should fly in June 1961.

The shape of the VC.10 (Vickers Type 1100) was evolved after more tunnel-test man-hours than with any previous Vickers aeroplane. It will be comparable in speed and payload-range capacity with the U.S. big jets but Vickers, in addition, decided "to concentrate on the airfield performance and economy of an aircraft that could cruise at 600 m.p.h." To this end—and to reduce noise and vibration in the cabin—the Rolls-Royce Conway engines are grouped at the rear of the fuselage to give a completely clean wing. Upon this wing full-span leading-edge slats and flaps can be employed to give maximum lift at low speeds and low cruising drag. A number of other important advantages claimed are low asymmetric thrust with two engines failed, no possibility of damage from jet efflux, maximum protection of the intakes and no likelihood of the engines touching the ground.

Main *Flight* references to the VC.10 are January 24, 1958, July 28, 1958, and October 2, 1959. A cutaway drawing appears on pages 618 and 619. B.O.A.C.'s contract price was £60m for 35 aircraft less spares.

Powerplant: Four Rolls-Royce Conway RCo.42 by-pass turbojets of 20,250 lb static thrust for take-off.

Dimensions: Span, 140ft; length, 158ft 10in; height, 39ft 1½in; wing area, 2,800 sq ft.

Weights: Max. take-off, 299,000 lb; max. landing, 197,500 lb; zero fuel, 176,500 lb; max. design payload, 38,000 lb.

Payload accommodation: Cabin volume (including flight deck) 6,500 cu ft; baggage and freight volume, 1,350 cu ft; cabin length, 91ft 4in; max. width, 11ft 6in; max. height, 7ft 6in; max. seats, 150 (six-abreast).

Fuel capacity: 17,300 Imp. gal (20,776 U.S. gal).

Performance: Cont. cruise speed, 480-510 kt (552-587 m.p.h.) at 30,000-40,000ft and 240,000 lb; balanced field length, I.S.A., sea level, 7,400ft; at I.S.A.+15 deg C, sea level, 8,650ft; at I.S.A. at 5,000ft, 9,500ft; landing distance, 6,400ft; range A (max. payload), 4,560 n.m. (5,250 st.m.); range B (max. fuel), 5,200 n.m. (6,000 st.m.); corres. payload, 22,500 lb; corres. speed 460 kt (530 m.p.h.) at 39,000ft (mean).

VC.11 Few details have yet been released about Vickers short-medium range jet "Viscount replacement." The general configuration will be that of a scaled-down VC.10. Power will be provided by four engines of Rolls-Royce divided-flow design.

INDEX BY AIRCRAFT NAME

Aerfer	578	Breguet 763	583	Coronado	593	Friendship	608	Marathon	609	Soient	614
Agusta A-Z-8	578	Breguet 940 941	583	Dakota	597	GL-207	612	Martin 2-0-2	612	Super Broussard	613
Airbus	582	Bretagne	615	Dart Herald	609	Goose	608	Martin 4-0-4	612	Super Constellation	611
Air Ferry	582	Bristol 170	583	DC-4	597	Gulfstream	608	Metropolitan	592	Supersonic Convair	693
Albatross	608	Bristol 205	586	DC-4M	586	H-107	609	MD-12	612	Supersonic Lockheed	610
Allison Convair	592	Bristol 216	586	DC-6 series	606	HD-321	609	MH-1521	613	Super Trader	579
Ambassador	597	Britannia	586	DC-7 series	606	HD-37	610	MH-250	613	Transall	613
An-10A	578	Britannic	614	DC-8	607	He.211	609	MH-260	613	Tu-104	615
An-14	578	Broussard	613	DC-9	607	Herald (Dart)	609	MH-280	613	Tu-110	620
An-16	578	C-46	583	D.H.80	593	Heron	590	Moscow (Moskva)	610	Tu-114	620
Anson	579	C-47	597	D.H.104	593	Hermes	609	Nord 2500 series	613	Tudor	579
Argosy	579	C-130B	612	D.H.106	596	H.F.B.200	608	Noratlas	613	Twin Pioneer	614
Armagnac	614	CL-44D	587	D.H.114	596	Hythe	614	Otter	597	Vanguard	621
ATL-98	578	Canadair 540	587	D.H.121	596	II-12	610	PBY.5	587	VC.10	621
Avia II-14	578	Caravan	613	D.H.123	597	II-14	610	Peking NR.1	613	VC.11	621
Avro 748	579	Caravelle	615	Doux Ponts	583	II-18	610	Pioneer	614	Viscount 700 series	620
Avro 758	579	Caribou	597	Dove	593	Integral	583	President	609	Viscount 800 series	620
AW.650	579	Casa 207 209	587	Dragon Rapide	593	Jetstar	612	Provence	583	Widgeon (Grumman)	608
AW.670	582	Catalina	587	Drover	597	L.10	610	Rainbow	613	York	579
Azor	587	Comet series	587	Eland Convair	587	L.12, 14, 18	611	Rapide	593	YS-11	610
BB-152	582	Commando	593	Electra (L.10)	610	L.049	611	Russia (Rossiya)	620	YS-12	610
Boeing 307	582	Constellation series	611	Electra (L.188)	612	L.749	611	Sahara	583	YS-12-4	610
Boeing 377	582	CV-240, 340, 440, 540	587	Elizabethan	597	L.1049 series	611	Sandringham	614	YS-31	610
Boeing jet transports	582	CV-600	593	F.27	607	L.1649A	611	S.C.7	614		
Beaver	597	CV-880	592	Freighter	583	Languedoc	615	Scandia	614		
				Freightship	608	Mallard	608				

SIGNALS COMMAND

Latest of the R.A.F. Commands PART 2

AN exciting physical impression of the world-wide area covered by Signals Command is gained from watching activity in the Central Signals Traffic Hall at Stanbridge, with messages coming in from and going out to all corners of the globe. The speed of signals traffic depends partly on priority, partly on routing (a signal from Singapore, for example, may come either via Ceylon or Nairobi). A message entering the system is manually transposed to Murray telegraph code at a speed of approximately 40 words per minute, but subsequent transmission and reception are automatic.

Messages are received and sent out on what is known as Chadless tape, and with 10,000 a day there is a great deal of tape involved, so an important part of Signals Traffic Hall organization is the efficient disposal of these flimsy scraps of paper. By means of a conveyor belt operators pass the message strips they have received to a central distribution point where they are put in differently coloured bags according to precedence. Sometimes, when the same message is addressed to several recipients, up to 18 copies have to be made. For outgoing signals, there are routers who decide upon the route and circuit to be used, depending on the degree of precedence and security instructions. To prevent the traffic hall looking like Broadway after a ticker-tape welcome message tapes are disposed of thirty minutes after transmission. Between January and November last year the station handled 2,614,000 messages, with a failure rate of only 0.0047 per cent. The 1959 figures show an improvement, with a rate of only 0.003 per cent.

Below ground at Stanbridge are the station's standby main power supplies, and batteries (in case of power cuts); the W/T room; and the G.P.O. apparatus room. Above ground a face-lift is taking place. One of the finished buildings, an airmen's mess, is in attractive contemporary style with spacious window areas. There are over 360 airmen and airwomen to cater for, and with a 24-hour watch there is a continuous meals service. Catering standards are high and a choice of seven courses typical.

The Radio Engineering Unit at Henlow occupies part of the station where the R.A.F. Technical College is based. Its purpose is the provision of radio engineering, installation and servicing facilities to meet commitments undertaken by Signals Command.

The R.E.U.'s main tasks are the manufacture, installation, recovery and limited fourth-line servicing of ground radio and test equipment; calibration of radio test equipment used by the R.A.F. in Europe; maintenance of test equipment transfer standards held by radio equipment calibration centres; compilation of calibration instructions for radio test equipments; and the manufacture of certain radio warfare equipment. It is liable to have, at any one time, some 360 tasks on order from Command.

This is a formidable list of duties, and in order to perform them the R.E.U. is organized into a number of squadrons and flights—headquarters squadron, which includes the task control flight; general engineering squadron; wireless engineering squadron; radar engineering squadron; radio installation squadron; equipment squadron; radio warfare flight; A.I.S. flight; No. 1 Test Equipment Calibration Centre; crystal re-processing flight; M.T. and M.T.R. and S. Flight; and a Special Signals Unit, located at R.A.F. Kidbrooke.

The R.E.U. commanding officer is G/C. P. H. S. Wood, O.B.E., who in his 37 years' R.A.F. service has seen a great many technological advances take place which are reflected in the wide variety of work undertaken by his unit.

Overall planning is done by the task control flight, which arranges for jobs which may take from half an hour or up to two years to accomplish, according to size and complexity. But the R.E.U.'s prime function is often interrupted to provide a "fire engine" service. During the Jordan airlift, for example, modifications were rapidly carried out to radar-equipped vehicles so that they could be transported by Beverleys.

G/C. P. H. S. Wood, who commands the Radio Engineering Unit at Henlow, discusses the report of a visit by Signals Command headquarters staff with W/C. H. L. E. Watson

Much of the R.E.U. premises resemble those of a light engineering firm, particularly in the machine-shop, where activity includes smelting alloys, spot-welding, general metal work, arc-welding, metal-spraying, painting, carpentering, electroplating and the manufacture of such items as control consoles for A.T.C. installations, from prefabricated metal parts.

The wireless and radar engineering squadrons' work includes manufacture and overhauls, modifications, rebuilding and refurbishing. Examples of tasks there earlier this year were the refurbishing of radio and radar vehicles, stripping-down and rebuilding Type 13 and 14 radars, constructing a G.C.A. prototype mobile workshop, converting a big trailer for moving heavy equipment and making Army radio sets into pack sets. An important activity is the rehabilitation of mobile radar convoys.

By contrast, the radio installation squadron does most of its work far away from Henlow, for it may be called upon to go to any part of the world, one of its chief tasks being the forming and sending-out of fitting parties. One of these has been at Gibraltar since last year, re-engineering the H.F. radio station there, which involves working on the Rock at 1,300ft. The total establishment of the squadron is just over 400 and its present strength about 360. There are 50 fitting parties, of which some 45 may be out at any one time.

It is not possible, for security reasons, to say much about the radio warfare engineering flight, whose work is tied up with the experimental flying carried out by Signals Command. The flight's engineering shop is capable of turning out a limited amount of equipment at short notice and is self-contained, though it may make use of the general engineering facilities of the R.E.U.

Requests for normal equipment (not of an experimental or prototype nature) go to the unit equipment squadron and supplies may come either from the M.U.s or from manufacturers. As a corollary to its supply duties, the squadron is also responsible for packaging equipment manufactured by R.E.U.

The test equipment calibration centre at Henlow is probably the largest of its kind in the world. Its job is to re-calibrate test equipment used by units in the field. A stock of serviceable items is kept and R.A.F. units in the U.K. and Europe are supplied by an exchange service delivery van. Calibrations are based on local standards which are only one order of accuracy below national ones, and the centre produces calibration booklets.

(Left) Mr. Eric Levy, an A.I.S. senior examiner, carrying out tests on a random-pulse generator at the R.E.U.

(Below) F/L. G. Trayford, who formerly commanded No. 810 Signals Unit, with W/O. R. Hewitt in the transmitting hall at Edlesborough

Mr. R. Hendley, supervisor at Barkway, master station of the Eastern Gee Chain, and the duty controller (seated), Mr. J. Hearn

Recording an oscilloscope reading on the air calibration of a radio navigational aid: F/Sgt. Hendry in a Varsity of No. 115 Sqn.

The crystal re-processing flight, staffed almost entirely by women civilian employees, re-activates used crystals and converts them to different frequencies. This saves the R.A.F. a great deal of money, because buying new ones for every frequency change would prove highly expensive.

R.A.F. Edlesborough is just west of Whipsnade and a few miles from Dunstable, and its aerial farm implies its function as one of the two main wireless transmitting stations in this country on the Commonwealth Air Forces Network. It has circuits to the Middle East (Cyprus), Nairobi, Ceylon, Malta, Ottawa, Delhi and Aden. The station is commanded by F/L. P. R. Batt; it was established just before the war and its equipment is used to produce multi-channel radio-teleprinter transmissions in the H.F. band. A continuous watch is kept and the majority of its staff are technicians, for the most part ground wireless fitters. All its circuits have main and secondary elements, and its longest direct link is 5,000 miles, with Ceylon.

Edlesborough's title is No. 810 Signals Unit. There are 27 transmitters at the station, 15 of them in constant use. In the event of power failure a standby power-house, using a diesel engine and manned by an A.M.W.D. engineer, comes into operation. Power can be restored within 30 sec, but the transmitters have to be warmed up before the circuits are connected again. Aerials used at Edlesborough are the diamond-shaped rhombic type; outside the buildings are the feeder poles, masts and towers. The staff can carry out up to and including second-line servicing; third- and fourth-line is done by the R.E.U.

"FLIGHT" PHOTOGRAPHS

R.A.F. Barkway, the next unit visited, is master station on the Eastern Gee Chain and, like all Gee units, is civilian-staffed. Its supervisor, Mr. R. Hendley, and his nine technicians are very loyal to their work, as evidenced by the epic story of how one of them struggled nine miles on foot through the snow last winter to get to Barkway. A four-watch system is maintained throughout the 24 hours; thus with two on at a time the station is run very economically.

Outwardly, the station consists of a squat-looking self-contained building dwarfed by its 360ft high transmitting tower. Equipment used is the Cossor display unit and Metro-Vickers transmitter; there are three of the latter, one being on the air at a time and another at standby. There is also a standby powerplant, and if power failure occurs the service can be restored in 1½ min. Naturally a Gee station, like the Windmill Theatre, never closes; when a slave gets temporarily out of alignment, alarm bells ring at slave and master station. Barkway is allowed up to two minutes for equipment changes (even a break of 25 sec has been commented upon by user aircrew). The timing control system between Barkway, as master station, and its slave is accurate to 1 part in 10^{12}. The Gee stations also serve the civil airlines and independent operators equipped to use them.

One of the two flying stations operated by Signals Command, R.A.F. Tangmere has had a famous and eventful history since its first squadrons of fighter aircraft arrived in 1926, and until last year continued to be in Fighter Command. Then with the re-basing of No. 1 Sqn., it looked as though this famous Sussex airfield might be closed; but after a few months' uncertainty Tangmere passed into the control of No. 90 Group shortly before it became Signals Command.

Two squadrons are based there, No. 245 with specially modified Canberra B.2s, and No. 115 with Varsities. Other Signals Command elements at Tangmere are No. 2 Ground Radio Servicing Sqn. and a Ground Radio Calibration Flight. In other respects the station is organized on normal R.A.F. lines, with flying, technical and administrative wings. Enthusiastic about its new establishment in Signals Command, Tangmere is also proud of its distinguished past. The station commander, G/C. W. D. David, D.F.C., A.F.C., is particularly conscious of a continuing tradition because he knew the station in pre-war days; and there is a physical link with the old times in the presence of many long-serving civilian employees.

The Signals Command flying and ground units at Tangmere are complementary, working in conjunction with each other and having as their joint task the checking and calibration of R.A.F. navigational aids and radar equipment in the U.K., R.A.F. Germany and Mediterranean areas.

No. 2 G.R.S.S. moved to Tangmere from Pucklechurch. Originally this radio servicing work was all done from Henlow, then in 1951 the organization was split up into four units. All electronic equipment in general use is dealt with by the G.R.S. squadrons: wireless, radar, G.C.A., C.R./D.F., ACR.7C and A.T.C. installations. As one of the officers of the Tangmere squadron put it, "Our job is to do work that units cannot do themselves." Calls for assistance may be received from some 120 units—using, between them, more than 40 different items of radio or radar equipment. As far as replacement or repair of equipment is concerned, No. 2 G.R.S.S. either brings the items back to Tangmere or sends out a party to do the job on the spot. As with many aspects of Signals Command activity, this work has to be done against time, the squadron's terms of reference expecting it to complete a job in twenty-four hours. No. 2 G.R.S.S., small in numerical strength, is responsible for an area which includes all of Southern England, the West Midlands, Wales, Gibraltar and certain units in Germany.

The ground radio calibration flight at Tangmere provides the ground element for air performance checks at the C.R. stations in this country as required, and some in R.A.F. Germany. But its principal work is concerned with ground recording during air checks of D.F. equipment. Parties are sent out to an installation and results recorded; these are brought back to base, analysed, put in graphical form and forwarded to Command headquarters, where the radio engineering branch assesses them and decides whether the equipment under scrutiny is operationally acceptable or not. When the flight works with the C. & R. system it uses one of the No. 245 Sqn. Canberras, but otherwise the Varsities of No. 115 Sqn. The strength of the flight is 65 and its programme of work is governed by what the squadrons are doing. As its members sometimes travel by air it is one of the few units where a National Serviceman is certain to get some flying. A G.R.C.F. D/F team comprises a sergeant ground wireless fitter, corporal technician and two or three operators (who may include National Servicemen). Draughtsmen in the drawing office of the G.R.C.F. have to complete their diagrams from the aircraft record—Decca log or Gee—to show how it relates to the machine's bearing at a particular time.

No. 115 Sqn. at Tangmere, operating Varsities, is commanded by S/L. F. P. Mulkern; and with 18 three-man crews on its strength has as its main task the calibration and checking of radio navigation and approach aids in the U.K. and elsewhere.

Its 14 Varsities bear on their sides the yellow "lightning flash" that denotes Signals Command. The aircraft, though basically T.1s, are in some instances modified for special installations. The squadron's work embraces both radio and radar equipment and the type of equipment it checks makes an impressive list—I.L.S.,

(*Concluded on page 626*)

This photograph of the cloud system associated with the "great Pennine wave" was taken from the Camphill site of the Derbyshire and Lancashire Gliding Club during the summer. Low cloud had just dispersed when the picture was taken, and the wave (caused by the Pennine range as a whole and not by an individual hill) persisted throughout the night

Sport and Business

EXHIBITED at the recent National Business Aircraft Association Convention in Minneapolis was the "executive suite" interior developed for the Lockheed JetStar by the American industrial designer Henry Dreyfuss. Illustrated in a photograph on this page, the interior features a new design of lightweight chair, constructed of glass-fibre and leather and mounted on a cone-shaped pedestal which swivels, slides fore-and-aft on tracks and reclines through 24 deg.

According to the Dreyfuss company, "The armchair is subtly shaped to fit the bodily proportions of every conceivable passenger, from the petite secretary to the lanky executive who once starred in college basketball. Travel fatigue is held to a minimum by five individually moulded cushions on the armchair's seat, back, arms and a separate section that supports the passenger's head. The back-cushion is precisely contoured to maintain the natural curve of the spine."

CLUB AND PRIVATE PILOTS' VIEWS on the operation of the special-rules zone around West Malling airfield are being solicited by the Royal Aero Club. These will be passed on to the Ministry of Aviation for consideration by the newly formed Air Traffic Control Board.

WOODFORD OLD ASSOCIATES, founder-members of Lancashire Aero Club, were entertained as guests of honour at a lunch party in the club's Barton premises on Saturday, November 14. The club's annual dinner-dance last month was attended by over 100 members and guests.

THE DUKE OF EDINBURGH has accepted honorary membership of Reading Flying Club, a Woodley-based group which complained last month when his Turbulent flight from White Waltham prevented several members of the club from flying.

NEXT YEAR'S MODELS of Piper aircraft include versions of the Tri-Pacer and Caribbean fitted with optional wheel fairings to increase cruising speed. Production of the 160 h.p. Tri-Pacer is continuing at a rate of four per day at the Piper factory at Lock Haven. In the most sophisticated of three standard versions, the Tri-Pacer "AutoFlite" features a transistorized, gyro-controlled automatic control system, in addition to full radio equipment and advanced instrument panel, which permits hands-off flight except during take-off and landing. This version of the machine incorporates omni-navigation facilities and is a completely equipped business aircraft with unrestricted cross-country ability.

Compared with the prices of $9,340 (standard) and $11,970 (AutoFlite) for the Tri-Pacer, the 150 h.p. Caribbean costs only $8,795 for the standard model. This machine is basically identical to the Tri-Pacer, except for its engine, and is intended to appeal in the club, flying school and private pilot market. Cruising speeds of Caribbean and Tri-Pacer (at 75 per cent power and 7,000ft) are respectively 132 and 134 m.p.h., with an increase of 4 m.p.h. available in the spatted versions.

RETROSPECT

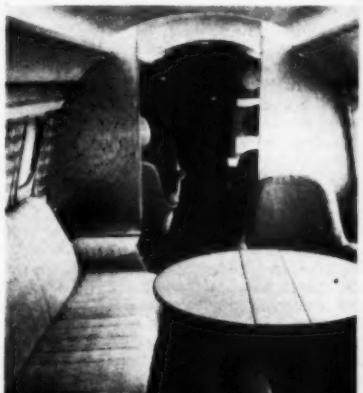
From "Flight" of November 20, 1909

Mr. Cody at Liverpool: By way of preparing for his attempt to fly from Liverpool to Manchester for the £1,000 Hartley Prize, Mr. S. F. Cody commenced practising with his machine on Monday on the Aintree racecourse. Two short flights were indulged in, and the second ended in a field about 3½ miles from the starting point, the hasty descent being necessitated by sparking-plug troubles.

On Tuesday afternoon Mr. Cody attempted to fly from Maghull to Aintree, but had not gone far before he met with misfortune. He went slightly off his course, and when trying to get back again found himself faced by a high hedge. He decided to come down immediately, but could not bring the machine to rest in time to avoid a collision with the hedge . . .

Mr. Cody will have to look to his laurels, for a rival has appeared on the Aintree course in the person of the Rev. S. Swann, Rector of Crosby, Ravensworth, who has a monoplane of the Santos Dumont type fitted with a 40 h.p. motor.

(Right) "Executive suite" interior developed by Henry Dreyfuss for the Lockheed JetStar



(Below, left) Royal interest in the Tipsy Nipper. The Duke of Edinburgh talks with Avions Fairey pilot Bernard Neefs at White Waltham

(Below, right) Displayed at the Poznan Fair this year was this mobile Polish single-drum glider winch. Behind it, the new 14-metre Pliszka (Wagtail) glider

Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

Take-off Monitors

HAVING read Mr. H. L. Warner's letter in the October 23 issue of *Flight*, I am prompted to make a few comments which may be relevant to his proposal for a ground-based take-off monitor.

If we consider a critical take-off where the speed for which the minimum stopping distance required is equal to the minimum stopping distance available is less than the rotation speed, it is obvious that if the decision to abandon the take-off is delayed until rotation speed is reached, then almost inevitably an accident will result.

In the majority of the large jet-transport take-offs, the decision speed occurs earlier than the rotation speed and therefore Mr. Warner's system is potentially quite dangerous. There is, however, no doubt that his system would permit a safer accident than would occur if the aircraft were allowed to continue to accelerate along the runway in the vague hope that it would eventually unstick.

Although not an airline pilot myself, I am aware of the opinions of a number of senior pilots, and almost invariably they require, quite rightly, that the pilot should carry the sole responsibility for deciding whether a take-off should be either continued or abandoned. At present the pilot is expected to make his decision with a very incomplete picture of the facts; and it appears to me, therefore, that the function of a take-off monitor is to provide the pilot with a complete history throughout the take-off, of achieved speed, acceleration and distance covered compared continuously with the scheduled performance.

Only with all of these facts before him can the pilot be expected to decide whether or not a satisfactory take-off is being achieved; Mr. Warner's system not only fails to give the pilot an indication of his progress, but also makes the decision when it is too late for him to do very much about it.

Mr. Warner's statement that other types of monitoring devices would not recognize the inability of the aircraft to develop sufficient lift to allow it to unstick is not entirely correct, as most of the factors likely to restrict lift development are likely to have an effect on the acceleration of the aircraft. Wing icing, if present in sufficient quantity to spoil the aerodynamic lifting capability of the wing, will certainly give rise to a drag increment which would be apparent at an early stage with a continuous monitor. It is also reasonable to expect that visual inspection of the wing condition would be made during the pre-flight checks. Similarly any inadvertent overloading of the aircraft would be indicated on the continuous monitor, provided the programmed performance was consistent with the intended weight.

The need for adequate take-off monitoring is already with us and if both the operations people and the pilots are to be reconciled to the idea of carrying additional equipment in the aircraft then this equipment should guarantee that the maximum safety is associated with an economically low rate of abortive attempts.

Aston Clinton, Bucks. B. M. LAVEN.

Export Opportunities

I WISH to refer to the letter entitled "It Isn't Done, Sir," by Mr. Barker of Sydney, N.S.W., published in *Flight* for September 29. Firstly I would like to say that I am in full agreement with all that Mr. Barker says, but would like to add that Australia is not the only market that suffers from the indifference of British salesmanship and showmanship.

I am mainly concerned with the apparent lack of enthusiasm to sell British civil aircraft in Latin America, which I consider to be one of the most readily available markets in the world, especially for medium-sized aircraft. Incidentally, this indifference is not by any means the sole prerogative of the aircraft industry; most other British industries seem to suffer from the same malady. This I consider to be a great pity, as from my own experience there seems to be a natural preference for the British and their products. In a great number of cases, however, it would appear that the Latin-American countries are forced to buy either American or German goods, by virtue of the following: (a) British indifference to their needs; (b) American and German super salesmanship and willingness to cater for a particular market and supply what is required when and where it is required; (c) substantially better payment facilities. I would also mention that Japan is now making a bid for trade in this area.

Before continuing further, I would like to quote one or two examples to illustrate my point. Until 1950, I believe, there was a branch of the British Chamber of Commerce in Lima, Peru. After a good struggle it finally had to close down because British business was not interested in selling or investing in Peru, even though there was a big demand for new equipment and new industries of all types. Since the end of the war Chile has founded a new steel industry at Huachipato, with the finest steel mills in Latin America. Clearly they did not have the experience to build or operate these themselves. They needed outside help, which they finally received from the Bethlehem Steel Corporation of America; and Chile is perhaps the most pro-British country in the whole of Latin America. Recently one of the largest iron deposits in the world was found in the north of Chile, in the region of San Pedro de Atacama. Here again it was the Bethlehem Steel Corporation that came in on the ground floor. It could have been a British firm in both cases. When the underground railway was built in Buenos Aires a contract went out for tiles to line the interior of all stations. English firms made no bid because, of all things, they said the order was too big for them to handle.

On the other side of the balance, though, I will admit that Bristols have sold Britannias to Cuba and Mexico, de Havillands have supplied Comets to the Argentine and Vickers have sold Viscounts to Cuba [and to 5 other Latin-American countries—Ed.].

Having said something about what hasn't been done, I must now turn to what I feel could be done. There are at present still flying in Latin America (according to *Flight* figures) 146 Curtiss C-46s, 457 Douglas DC-3s and C-47s, and 56 DC-4s and C-54s, not to mention numerous aircraft of similar vintage (and some of a pre-war vintage even). This suggests a wonderful market for new aircraft, especially in the prop-jet field.

Aircraft that immediately come to mind as being the most suitable for this market are the AW.650, Avro 748, Comet 4 series, Fairey Rotodyne, Dart Herald, Twin Pioneer, Viscount, Vanguard, VC.10, and Britannia. Of these aircraft I feel that perhaps the most immediate market would be for the Avro 748 and the Dart Herald, which have been built especially to replace the DC-3. I agree that many of the earlier aircraft mentioned have a fair number of flying hours left in them, but at a rough estimate I should say that a good 50 per cent of them are ready for replacement now.

I am convinced that, armed with reasonable delivering dates and generous payment schemes, these aircraft could be made to sell like the proverbial hot cakes. So come on, manufacturers and bankers, why not get together on the lucrative market and see if you can't make something of it?

Halton, Bucks. R. A. THOMAS, F/O.

Twisted?

LEAVING aside the "popular" Press interpretation of what people really said or really thought about Prince Philip's flight at White Waltham, I found Roger Bacon's remarks a little bit too cynical to digest.

I am quite sure that all of us admire Prince Philip for his desire and keenness to fly—especially "real" aeroplanes as opposed to flying fuel-systems.

Normally I read the "Straight and Level" page with interest, but after this acid comment I suggest you call it Bitter and Twisted.

Luton, Beds. D. G. CAMPBELL, C.F.I., Luton Flying Club Ltd.

FORTHCOMING EVENTS

Nov. 20. R.Ae.S. Graduates' and Students' Section: Winter Dance.
Nov. 20. Institute of Navigation: "Radiometry, Radio-Astronomy and Infra-red Techniques," by C. M. Cade.
Nov. 20. Institute of Transport (Swindon Group): "The History of the Aeroplane," by W. A. Kendall.
Nov. 24. Institute of Transport (West Middlesex Group): "Economics of Long Haul Air Transport," by J. B. Scott.
Nov. 24. R.Ae.S.: "Heat and Mass Transfer in Aeronautical Engineering," by Professor D. B. Spalding.
Nov. 25. Air Public Relations Association: Annual Reunion.
Nov. 25. Society of Environmental Engineers: "Investigation of Jet-induced Vibration," by M. O'B. W. Wolfe.
Nov. 25. Kronfeld Club: "The BEAline entry in the *Daily Mail* Race," by Peter Brooks.
Nov. 26. R.Ae.S. Third Lanchester Memorial Lecture. "Boundary Layer Research in the last Thirty Years," by Professor Dr. G. Schlichting.
Nov. 27. R.Ae.S. Man-Powered Aircraft Group: "Man as an Aero Engine," by Dr. D. R. Wilkie.
Dec. 1. Guild of Air Pilots and Air Navigators: "Aircraft Propulsion. Present and Future," by J. A. Barnes.
Dec. 1. R.Ae.S.: "Transonic Flow over Swept Wings," by E. W. E. Rogers.
Dec. 2. Association of British Aero Clubs: Annual Dinner.
Dec. 2. R.Ae.S. Graduates' and Students' Section: "Aerodynamics of Racing Cars," by F. A. Costin.
Dec. 3. R.Ae.S. Main Lecture (at Gloucester and Cheltenham Branch): "Some Servo Mechanisms for Supersonic Aircraft," by S. G. Glaze.
Dec. 4. Helicopter Association: "Aerodynamic Aspects of the Fairey Rotodyne," by K. McKenzie.
Dec. 8. R.Ae.S.: "Some Practical Aspects of Compressor Blade Vibration," by Dr. E. K. Armstrong and R. E. Stevenson.

R.Ae.S. Branch Fixtures (to Nov. 27): Nov. 24, *Belfast*, film night. Nov. 25, *London Airport*, "Air Traffic Control," by L. Woodruffe.

SIGNALS COMMAND (continued from page 623)

BABS (Mks 2 and 4), G.C.A. and ACR.7 precision approach aids, TACAN, U.H.F./D.F., V.H.F./D.F., H.F./D.F., standard beam approach system, P.A.R., Eureka Beacons, and Gee. When I.L.S. is being calibrated three extra crew are carried—a navigator, pack set operator and civilian technician. When I.L.S. and BABS Mk 4 are under air check a theodolite is used, being set up along the course line. The aircraft is flown visually along the line, guided by the theodolite operator, and recordings made in the aircraft are then compared with a known specification. G.C.A. equipment is air-checked every six months and I.L.S. every three months. On such work, the squadron's average monthly flying is 400-500 hr, but the number of jobs done is regarded as more important than hours flown. Some tasks, for example at Idris and Gibraltar, take several hours' flying to reach. No. 115 Sqn. accomplishes 60 to 70 tasks in a month. All its pilots have Green or Master Green ratings, and the squadron also has on its strength four G.C.A. controllers and four marshallers.

The Canberras of No. 115's sister squadron at Tangmere, No. 245, perform on weekdays what is modestly called "the milk run." Each morning two of the Canberras take off on 40,000ft runs to check the C. & R. early-warning radars. One goes northwards around the U.K. area, and another southwards round the R.A.F. Germany area. This task, which the squadron has been carrying out for the past three years, demands very accurate flying. Courses have to be steered to plus or minus half a degree and height kept to within 100-150ft, and at ten-minute intervals the aircraft broadcasts its position. For navigational purposes, the Canberras are equipped with Mk 3 Gee and Decca 7 or 8. The squadron has eight aircrews (each consisting of a pilot and navigator) and seven aircraft, six of them B.2s and the other a T.4 which is used for training. Each crew does four hours' day and four hours' night continuation training per month. The squadron's daily chore is carried out whatever the weather, provided there is one diversion airfield open, and on average a total of 160 hr flying a month is achieved. At Tangmere the weather factor is usually good (it used to be a master diversion airfield, and still often acts in a diversionary capacity). It has C.R./D.F. and BABS as aids; and the Canberras, which carry tiptanks, have a maximum endurance of four hours at Mach 0.72.

The A.O.C-in-C. Signals Command, A.V-M. Sir Leslie Dalton-Morris, is obviously very proud of his Command. One question I asked when I had the privilege of meeting him at Medmenham was whether the elevation from Group to Command status has made any difference to the organization's work and responsibilities. He said it had not, but it had cleared up the anomaly of something called 90 Group being listed with the Commands; furthermore, overseas Commands preferred to have an inspection visit from a Command, rather than a Group, headquarters. He added that the other Cs-in-C. had for some time been in favour of the change from 90 Group to Signals Command; he himself has the additional title of Inspector of Radio Services.

The C-in-C. countered a question about manpower I had put to his S.A.S.O.—the shortage of operators when National Service ends and the lack of recruits for specialized branches (mentioned in this year's Defence White Paper)—by asking bluntly: "What would you do?" The answer was not flippant or nonchalant: the C-in-C. has too quick and dry a sense of humour for that (though no doubt he can be fierce on occasion): it is clear that Signals Command are thinking hard about this problem. A.V-M. Dalton-Morris went on to speak of another manpower change, the "civilianizing" of Canberra crews on the daily calibration runs from Tangmere. Then, speaking generally of his Command, he referred to the famous 90 Group catering competitions and asked his A.D.C. (F/L. A. W. Law) to produce some coloured photographs giving a vivid impression of these culinary triumphs. He also said that the rebuilding programme for the headquarters at Medmenham was to be completed in five years.

This reconstruction will give adequate and well-laid-out accommodation for the directing staffs of Signals Command, whose importance is daily increasing and whose great reputation —as the Chief of the Air Staff put it at the inaugural dinner—is likely to be further enhanced in its new status. H. W.

THE INDUSTRY

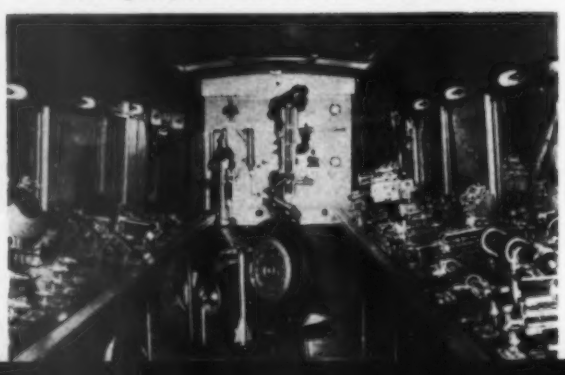
Inspection Equipment on Show

IN London last week Taylor, Taylor & Hobson, of Stoughton Street, Leicester, held a special exhibition of their current inspection, test and other equipment. On view were several instruments of particular interest to the aircraft industry, such as the "Micro" alignment telescope, which provides a basic method of aligning large assemblies and checking parallelism of surfaces. This instrument has found considerable application in the setting up of aircraft jigs: it has been used, state the makers, in the manufacture of both the de Havilland Comet 4 and the Boeing 707. With the addition of a telescope lamp-house, auto-collimation, auto-reflection and alignment-projection readings can be obtained over distances of up to 60ft or more.

An entirely new instrument shown was the "Talyvel" level indicator, in which the usual bubble is replaced by a pendulum with transducers; these provide a displacement signal for transmission to an amplifier feeding a centre-zero meter having three optional ranges of arc—50 sec, 100 sec and 8 min, in each case to the full scale of the dial. The instrument has particular value in the erection of machinery.

Other equipment in the Taylor-Hobson range, much of which was demonstrated at the exhibition, includes the well-known "Talysurf" and "Talyrond" instruments, microscopes (including an edge microscope for turbine blades), various optical gauges, automatic gauge control and auto-sizing equipment, and light machine-tools.

The Dowty mobile instructional school has recently been in Switzerland, where the instructor, Mr. T. H. B. Davies, has been lecturing Swiss Air Force personnel on the Dowty equipment used in their Hawker Hunters; some 70 of the hundred aircraft ordered have already been delivered. Exhibits in the coach comprise over 30 sectioned units, including complete Hunter main and nose undercarriages



IN BRIEF

Mr. James E. Robinson, M.I.Mech.E., M.I.Mar.E., chief engineer of Hepworth & Grandage Ltd., has been appointed a director. He will continue in his capacity as chief engineer.

Mr. L. Schepers, a managing director of the Royal Dutch/Shell group of companies, has been appointed chairman of the Shell Chemical Co. He succeeds Mr. F. A. C. Guepin, who retired last June.

Mr. Michael J. S. Clapham, who has been joint managing director of I.C.I. Metals Division since October 1952, is to be chairman from January 1 next year. He succeeds Dr. Maurice Cook, C.B.E., who is retiring on December 31.

From P. W. Allen & Co., 253 Liverpool Road, London, N.1, come details of the Allen A.90 workbench light, a neat, adjustable unit utilizing a miniature fluorescent tube which gives the advantage of brilliant light without heat, shadow or glare.

"Diamond H" Switches Ltd. of Gunnersbury Avenue, London, W.4, are marketing a new series (80A-82A) of miniature neon indicator units. Supplied with current limiting resistors and suitable for 115, 250 or 415V currents, they are available with round chromium plated trims of ⅛in or ¼in diameter.

Thirty-seven "Thermostor" storage heaters—product of E. K. Cole Ltd. of Southend-on-Sea—are installed in the Southend Airport terminal building extension. The installation, carried out by the Eastern Electricity Board, has a total loading of over 70 kW. With this system, a reserve of heat built up during off-peak periods is emitted continuously at other times.

Nash & Thompson Ltd. recently announced the addition of an ohmmeter and a flash tester to their range of miniaturized electronic test equipment. The ohmmeter, it is stated, will measure resistances between 10 ohms and 10,000 ohms in eight ranges to an accuracy of ±3 per cent. The flash tester, designed for insulation testing to BS. 816 (1952), provides a 50 c/s. A.C. test voltage variable from 500 to 2,000 volts in sixteen 100-volt steps.

Auto Diesels Ltd. announce "a marriage of convenience" between themselves and Frederick Braby & Co. Ltd., adding that hereafter Auto Diesels Ltd. and subsidiaries, Diesel Equipment Ltd. and Norman Industrial & Marine Co. Ltd., will be members of the Frederick Braby Group. Mr. Frederick Braby and Mr. Cedric Braby have joined the Auto Diesels board and Mr. A. J. W. Green and Mr. L. W. Parncutt have been elected to the Braby board.

A Sycamore of the Joint Experimental Helicopter Unit was used recently to ferry a new type of helicopter external load-carrier control from the Basildon, Essex, factory of Teleflex Products Ltd. to the J.E.H.U. base at R.A.F. Middle Wallop. Flown by S/L. Twigg, the Sycamore also conveyed Mr. L. A. Murray, assistant chief designer of the Teleflex aircraft division, Mr. T. Joyce, a development engineer, and Mr. A. C. Eggierth, an experimental fitter.